SCIENCE.

FRIDAY, DECEMBER 28, 1883.

THE CHIEF SIGNAL-OFFICER'S REPORT.

THE report proper of the chief signal-officer of the army for the year ending June 30, 1883, has been published in advance of the complete volume, which will contain the usual appendices. When compared with those of previous years, it presents a marked and most gratifying contrast. The useless and tiresome repetition of much that has appeared regularly since the organization of the service is no longer indulged in; and, in fact, the present report is brief, fresh, and vigorous. It is pleasant to see, that, among the various topics discussed, the first place is given to 'Instruction in meteorology.' Although somewhat crippled by lack of sufficient appropriation, this work has not been allowed to retrograde; and the encouraging fact is noted, that, out of a hundred and seventy-two enlistments made during the past two years, fifty-three were college graduates.

Gen. Hazen argues ably and pointedly against the inadequate provision made by the last Congress. The separation of the signal-service from the army proper, as far as its support from the general appropriation goes, undoubtedly left the service in a worse condition, even, than was intended by those who sought to reduce its expenditures. The result has been, that a number of stations have necessarily been closed, and much important work of the weather bureau has been suspended. It is certainly to be hoped that it may receive more generous treatment at the hands of the present Congress.

An interesting *résumé* of the scientific work of the weather bureau is given, which indicates a commendable activity in that direction. One of the most important announcements is, that a new standard of thermometry has been adopted "which no longer agrees with that of the Yale college observatory, but approaches more nearly to that of the International bureau of weights and measures." Another is, that steps have been taken to inaugurate in the immediate future a series of elaborate observations upon atmospheric electricity. The continuation of the publication of 'Professional papers' by members of the scientific corps is noted, one of the most important of which is that on 'Movements of the atmosphere,' by Professor Ferrel. It is gratifying to observe throughout the report, that scientific meteorology is receiving a recognition to a degree much greater than formerly.

A brief history of the unfortunate Greely expedition is presented, and the statement made that it is intended to apply for an appropriation to enable another relief expedition to be sent out in 1884.

The report covers twenty-two pages, instead of three or four times that number, as was the case in previous years; but, as a report of progress for the year, it is much more valuable than its predecessors. A similarly judicious treatment of the appendices and meteorological summaries, which will follow this report, would bring the whole into a much more useful and manageable form, and would not be the least important of the many reforms introduced into the service by its present chief.

No. 47.—1883.

ROMALEA MICROPTERA.

SHOULD the return of spring be early, and the winter just passed an open one, a rambler in the meadows of southern Louisiana is very likely, during the middle of February, or perhaps even earlier, to have his attention drawn to curious little colonies of red and black grasshoppers.

These are the young of Romalea microptera. Until this summer I never saw a living adult specimen of this handsome insect, and my examination of it had been confined to a few individuals in alcohol. No sooner, however, had I thoroughly examined one of these little

red and black colonists, than it struck me that they must be the young of the great black grasshopper I had seen in spirit. This was subsequently confirmed for me through the kindness of Mr. L. O. Howard, of the Agricultural department at Washington. One day last March, during the first part of the month, while on one of my collecting excursions in this country, my way lay through an extensive cypress-swamp. The only good footing was along a low, straight embankment, that had been made by the earth thrown out to dig a canal, to which it now formed the bank on one side. It was composed of a dry, black soil, upon which the new spring grass and the earlier plants had just commenced to make their appearance. It was here that I first came across a family, or brood rather (for no old ones are to be found at this time of the year), of the young grasshoppers in question. They extended obliquely across my path in nearly a straight line, about half a yard in length, and from three or four to a dozen or more individuals in width. Where small dry twigs occurred, or blades of grass, in their course, they completely covered them, and were so packed together that in some parts of the group they crowded each other a good deal. When first discovered, little or no activity among them was apparent; but no sooner did I commence to lay in a store of specimens than the survivors of my attack immediately began to hop off in all directions, obliging me very soon to make single captures. At this stage of their growth, these insects are about of the same size, having an average length of a centimetre; their general color being a deep, shiny black. This is set off by fine lines of brilliant vermilion, occurring at different places on the body. One strip extends mesiad, the entire length of the dorsal aspect, from a point between the antennae to the posterior extremity of the abdomen; another bounds, on either side for a short distance, the hinder margin of the prothorax; while the same is found behind the whole length of each of the hind-femora. The lower and posterior angle of the epicranium is also bordered by the same color as is its inferior margin in front, and a line that extends down from the eye on either side to join it. Finally we observe that each abdominal ring is emarginated in the same way, along the ridges of the pleurite portions, below the spiracles. At this age the antennae are half as long as the body.

A few weeks later, when they are about double the size I have just described, we begin to observe in these collections, which are apparently all of the same crop, some specimens considerably larger than the general run. These may be females, but this I cannot positively assert: though, as the insect grows, these larger ones maintain their size over the others; and later in the year we find them to be females, notwithstanding the sexes at these times seem to be pretty equally divided in numbers.

In the middle of June, a field in the vicinity of New Orleans, where the grass had grown to be about waist-high, was covered in one or two places of no great extent with these grasshoppers. They now ranged from four to five centimetres in length, and could be seen at several hundred feet distance. Other varieties of plants were covered with them; but I found none on the ground, unless they were accidentally knocked down, or jumped down when one failed in his efforts to capture them.

At these times they are very sluggish, emitting no sound or note that I ever heard, and do not seem to be feeding on the vegetation upon which they congregate. Their colors are now somewhat changed; and, though the black is as deep and shiny as ever, the red gradually fades to a brilliant orange, and a small pair of dull black wings commences to make its appearance.

In the country about New Orleans, Romalea seems to attain its full growth some time in the early part of July. This is denoted by the general appearance and habits of the insect: certain parts of his exoskeleton have become firm and hard, and all his structures and organs bear evidence of maturity. They are no longer found in groups in the meadows and forests, but dispersed, and occurring in all sorts of localities. Hundreds of them are found invading the cow-paths and roadways: others climb on fences and trees. Many still are yet observed, though now usually singly, on high grass and plant-stalks; and these we may easily discern at a long distance in the open fields. Even our houses are not altogether exempt, at this season, from this black-mailed vagrant. Many are killed by being trodden upon, or accidentally crushed in other ways; for they are slow to get out of one's road, and disinclined to jump much, — a feat in which the males, from their lighter weight, far exceed the larger and heavier females.

It is about this time of the year that we first begin to notice any thing approaching an *affaire d'amour* on the part of this now truly handsome insect. We now see many couples apparently regardless of those who behold their awkward and highly fantastic addresses. The

only sound that I have ever heard this grasshopper give vent to, is now indulged in by the male. It consists simply of a series of peculiar hisses (this word expresses it better than any thing else), and is only heard when we seize and handle one of them, or during their mating. The sound seems to be produced largely by the wings; for these members are elevated at this time, as I have shown them in my plate, where the male exhibits his beautiful hind-wings, — a relief to his otherwise sombre tints that is only to be experienced on such occasions.

I am of the impression that Romalea does not confine itself to any particular diet, but is rather a general feeder, choosing such plants as happen to fall in its way. Some of them, that I kept alive for several days in a large box, fed upon almost any thing in the shape of vegetable growth that I offered them.

This view seems to be sustained by the report of Mr. L. O. Howard, who saw them in August in immense numbers in the rice-fields about the city of Savannah; 'yet they seemed to do little damage to the rice.'[1]

This observer tells us in the same report, that they are known in that locality among the people as the 'lubber grasshopper,' whereas, throughout this section of the country, they are called by every one the 'devil-horse.' Perhaps, if at one of their grand councils they had a choice in the matter, it would be hard for them to decide which was the prettier name, and no doubt they would vote unanimously to select some other one.

It has never been my fortune to find examples of the black variety of the female in southern Louisiana, as observed by entomologists elsewhere.[2]

On the 28th of last July, while engaged in looking for a specimen of the prothonotary warbler, which I had just brought down with my cane-gun from a magnolia under which I stood, my attention was attracted by a large female Romalea, with part of her abdomen buried in the ground, and evidently in the act of depositing her eggs. A chapter in the history of this insect at once flashed across my mind; and, in my undue eagerness, I removed her at once from the little excavation she was in on the ground; but the most careful search afterwards was not rewarded by the discovery of a single egg. However, the satisfaction was afforded me, at the subsequent *post mortem* of the specimen in question, of finding her ovaries containing upwards of fifty bright-yellow, spindle-shaped eggs, each about a centimetre long.

[1] Report commiss. agric., 1881-82, p. 138. [2] *Ibid.*, p. 138.

This circumstance convinced me that Romalea microptera deposits its eggs in the ground; and from that time I did not allow an opportunity to slip in searching for them. My interest in this matter was only increased by receiving a letter, a few days afterwards, from Mr. Howard, in which he informed me that it was not known where this grasshopper laid its eggs. I am sorry to say that I have not had the opportunity to examine the reports made by Glover upon this insect, in the report of the Department of agriculture for 1872, kindly called to my attention by my correspondent, nor the mention made of it in Ashmead's 'Orange insects,' also referred to by him.[1]

My search was, however, afterward rewarded; for on the 15th of August, while passing through a long, flat meadow a few miles from New Orleans, I came, at one end of it, to a little low mound about ten yards in extent, composed of a dry black earth, that was cracked and fissured in many directions by a sun that streams down here almost as mercilessly as in the tropics. Many tall weeds and grasses surrounded this miniature hillock, and others grew upon it.

Romalea had made this elevation its headquarters, and it was at the same time a rendezvous for many couples who had apparently postponed their honeymoons. The importance of the occasion was evident; for there was not a male on the ground, to say nothing of the majority who were perched up in the weeds, but was strutting about in the most business-like manner, or trying to do so on their perches in the latter. Whatever part of the entertainment these sable gentlemen entered into, they constantly kept up a very audible buzzing racket with their wings, which they elevated and lowered at few seconds' intervals, showing the inferior carmine pair each time they did so, with telling effect. At these times they assume the position in which I have drawn one in the plate, walking about in a stilted manner, but bearing, withal, a dignified mien, rattling their wings, and paying their court to the quieter and more sedate opposite sex.

Some of the females kept apart, and bore the appearance of being dejected, tired of the gayeties of the season, and otherwise bored by the proceedings that were going on everywhere about them. It was the sight of these satiated dames that soon brought the thought to my

[1] I have since ascertained that Mr. Charles R. Dodge, of the Agricultural department of Washington, has raised the young of Romalea from eggs that were laid by specimens he kept in confinement. He published his observations in the *Rural Carolinian* (April, 1874, p. 363, vol. v., no. vii.), Charleston, S.C.; and subsequently in the *Field and forest* (ii. 1877, p. 160), Washington, D.C.

mind, that perhaps they laid their eggs here too; and acting immediately upon this, as well as the suggestive fissures in their camping-ground caused by the sun, I proceeded to investigate those likely places in which they might deposit their ovicular treasures. These rents presented every stage of being filled in from one cause or another; and I had hardly commenced to scratch out the earth from one that was partially in this condition, than I came across masses of their eggs. They were not easily observed at first, as I turned them out with the stick I used in searching for them, from the fact that they resembled lumps of earth, as this substance adhered to their entire surface, either dusted over, or in little fragments, which latter rendered the resemblance still more deceptive. My plate represents one of these masses, that has been well cleaned off, in the lower right-hand corner (marked *A*). I have four before me that were collected at the time of my observations, and one of these is that figured in the plate.

The first of these masses that I pick up contains about thirty-five eggs, of a like size and shape to those removed from the body of a female several weeks before. They are in one rather irregular layer, being placed roughly parallel to each other, and entirely incased by the pellets of earth that have adhered to the mass. No true egg-pod was observed to enclose them; but, judging from the way in which the eggs of other large grasshoppers are laid, no doubt further observations will prove its existence. The eggs of this lot are all sound, and in an apparently safe condition till the time of hatching, as they were several inches below the surface of the ground. In the next collection the mass is of a circular form, with the eggs arranged pretty much as we found them in the first lot. Here, however, they are quite distinct, being simply dusted over with a little earth; and I find several of them have been opened at the sides, and their contents removed, apparently by ants or other insects. The two remaining masses are essentially of the same description as those we have just described. One is a little different in shape, being oblong instead of circular. This form may have been forced upon it from the narrowness of the fissure in which the eggs of this lot were laid. Of these four deposits, we may say that they contain an average of thirty eggs apiece; and this statement, no doubt, will be very near the correct one for the usual number found in such masses.

Examining one of these eggs under a two-inch objective, we find it composed of an outer coat, brown in color, fibrous in texture, and about 0.1 of a millimetre in thickness. The little fibres are placed side by side, and vertical to the surface of the egg. This coat fractures off in small pieces quite easily, and, in so doing, exposes the thin membranous and transparent inner coat, which allows one to see through it the amber-colored contents of the egg proper, which are of a viscid character and of about the consistency of old olive-oil.

This was the only occasion upon which I ever succeeded in finding any of the eggs of this grasshopper; and I am unable at the present writing to say how many times they deposit during a season, or how often Romalea moults during the same period.

It was my intention, when I commenced this paper, to enter to some extent upon the anatomy of this insect; but the idea was eventually abandoned from the fact that the anatomy of locusts and grasshoppers has been very ably and extensively worked up by many entomologists: so, to enter upon this subject at all in the present case would entail a minute study of details and comparisons that would result in carrying my paper much beyond its intended limits. Then, too, so far as the external appearance of Romalea is concerned, I have made every effort to convey a correct idea in my plate, both of the male and the female; and this work has been most carefully and beautifully reproduced by my engravers, Messrs. T. Sinclair and Son of Philadelphia, — a firm to whom our scientific men are under so many obligations for faithful reproductions of their work. This sketch, in its present form, then, is offered to the readers of Science as a contribution to the life-history of Romalea microptera; and it is hoped that in it at least a few facts will be discovered that will prove of interest to entomologists.

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Captain Medical corps, U.S.A.

RESOLUTIONS OF THE INTERNATIONAL GEODETIC COMMISSION IN RELATION TO THE UNIFICATION OF LONGITUDES AND OF TIME.

The seventh general conference of the International geodetic association held at Rome, and at which representatives of Great Britain, together with the directors of the principal astronomical and nautical almanacs and a delegate from the Coast and geodetic survey of the United States, have taken part, after having deliberated upon the unification of longitude by the adoption of a single initial

Science Dec 28th 1883.

R.W. Shufeldt, del.

T. Sinclair & Son, Lith Phila.

ROMALEA MICROPTERA.

meridian, and upon the unification of time by the adoption of a universal time, has agreed upon the following resolutions: —

1°. The unification of longitude and of time is desirable as much in the interest of the sciences as in that of navigation, of commerce, and of international communications. The scientific and practical utility of this reform far outweighs the sacrifice of labor and the difficulties of re-arrangement which it would entail. It should, then, be recommended to the governments of all the interested states to be organized and confirmed by an international convention, to the end that hereafter one and the same system of longitudes should be employed in all institutes and geodetic bureaus, for general geographic and hydrographic charts, as well as in astronomical and nautical almanacs, with the exception of those made to preserve a local meridian; as, for instance, the almanacs for transits, or those which are needed to indicate the local time, such as the establishment of the port, etc.

2°. Notwithstanding the great advantages which the general introduction of the decimal division of a quarter of the circle in the expressions of the geographical and geodetic co-ordinates and in the corresponding time-expressions is destined to realize for the sciences and their applications, it is proper, through considerations eminently practical, to pass it by in considering the great measure of unification proposed in the first resolution.

However, with a view to give satisfaction at the same time to very serious scientific considerations, the conference recommends, on this occasion, the extension, by the multiplication and perfection of the necessary tables, of the application of the decimal division of the quadrant; at least, for the great operations of numerical calculations for which it presents incontestable advantages, even if it is wished to preserve the old sexagesimal division for the observations, for charts, navigation, etc.

3°. The conference proposes to governments to select for the initial meridian that of Greenwich, defined by a point midway between the two pillars of the meridian instrument of the observatory of Greenwich; for the reason that that meridian fulfils, as a point of departure for longitudes, all the conditions wished for by science, and because, being at present the best known of all, it offers the most chances of being generally accepted.

4°. It is suitable to count the longitudes, starting from the meridian of Greenwich, in the sole direction from west to east.

5°. The conference recognizes for certain scientific wants, and for the internal service in the great administrations of routes of communication, — such as the railways, steamship-lines, telegraphic and post routes, — the utility of adopting a universal time, along with local or national time, which will continue necessarily to be employed in civil life.

6°. The conference recommends as the point of departure of universal time and of cosmopolitan dates the mean noon of Greenwich, which coincides with the instant of midnight or with the commencement of the civil day, under the meridian situated twelve hours, or a hundred and eighty degrees, from Greenwich.

It is agreed to count the universal time from 0 hour to 24 hours.

7°. It is desirable that the states which, with a view to adhere to the unification of longitudes and of time, find it necessary to change their meridians, should introduce the new system of longitudes and of hours as soon as possible.

It is equally advisable that the new system should be introduced without delay in teaching.

8°. The conference hopes, that, if the entire world agrees upon the unification of longitudes and of hours by accepting the meridian of Greenwich as the point of departure, Great Britain would find in this fact an additional motive to make, on its part, a new step in favor of the unification of weights and measures by adhering to the *Convention du mètre* of the 20th of May, 1875.

9°. These resolutions will be brought to the knowledge of the governments, and recommended to their favorable consideration, with an expression of a hope that an international convention — such as the government of the United States has proposed — for confirming the unification of longitudes and of time should be decided upon as soon as possible.

ORIGIN OF THE MESODERM.

THE origin and composition of the mesoderm has been the subject of perhaps more discussion than any other single point in the whole range of embryology. Observers have given the most conflicting statements, for the most part due to incomplete observations; but now we are at last in a position to eliminate many of the false descriptions and to harmonize fairly well those we must regard as correct.

The first important advance was accomplished by His, who made the fundamental discovery that the mesoderm is not homogeneous,

but double, in its origin. The ectoderm, entoderm, and part of the mesoderm, he distinguished under the common name of 'archiblast,' from that portion of the mesoderm which is related to the connective-tissue group (connective tissue proper and endothelia), and which he supposed to grow from the yolk (in the chick) into the archiblastic tissue or cells, which, from the first, are constituent elements of the embryo. His maintained that the parablast-cells were derived from the white elements of the yolk, but in that respect he is believed to be in error; nevertheless to His belongs the great honor of having first insisted upon the duplex development of the middle germ-layer. This knowledge is the key to the solution of one of the fundamental problems of animal morphology.

The researches of Professor His have been confined to vertebrates. One cannot but feel that his views would have been modified in many details, if he had included the lower types, also, in his investigations. The discoveries of others, however, have gradually made it clear that among invertebrates, also, the twofold composition of the mesoderm exists. The path to this generalization may be said to have opened out upon the announcement by Alexander Agassiz that in echinoderms the lining of the body-cavity and water-vascular system is derived from the entoderm. Selenka and others have since shown that the rest of the mesoderm is derived from scattered and isolated cells, which are thrown off from the other layers into the space between the ectoderm and entoderm. It was thus clearly shown that in this class of animals the mesoderm primitively consists of two epithelial evaginations and of scattered and independent cells of amoeboid character. The fundamental importance and the far-reaching significance of this discovery were unfortunately not appreciated at the time.

For several years past I have been accumulating materials for a work on 'Comparative histology,' and have meanwhile directed my attention chiefly to the classification and genesis of tissues. These preliminary studies led me to various conclusions, among which was the conviction that amoeboid cells were the primitive representatives of the mesoderm, and that from them was derived a large part of the mesodermic tissues. This view I published in 1879;[1] but the article has, so far as I am aware, been entirely overlooked by subsequent writers, and I therefore venture to call especial attention to it now, as the opinion I then advocated has since become a current embryological generalization. To the cells I gave the name of 'mesamoeboids.'

The investigations of Hatschek, whose brilliant discoveries have not yet received their deserved recognition, have revealed that in Bryozoa, Mollusca, Annelida, and Amphioxus, the mesoderm arises, 1, from cells, such as we have seen may be classed under the head of mesamoeboids; 2, from two paired masses of cells, his 'mesodermstreifen,' whose origin from the entoderm is rendered probable in all cases, and certain in some, by known characteristics. These stripes either have from the first, or soon acquire, a distinctly epithelial structure. Hatschek appears to have recognized the bearing of his observations nearly as we conceive it now; and to him, I think, we should accord the honor of having first clearly and definitely recognized the dual histogenesis of the mesoderm.

F. M. Balfour, in his writings, particularly in his 'Treatise on comparative embryology,' made the next important step by pointing out that the vertebrate mesoderm probably arose as a pair of diverticula from the gastrula cavity; and he gave a new meaning to, and justification of, this theory, by insisting upon the homology between the blastopore of the Ichthyopsida and the primitive streak of the Amniota; for from the walls of the former, as well as from the substance of the latter, the paired outgrowths of the middle layer arise. The deficiency in Balfour's presentation of the subject lies in his failure to recognize the importance of the mesamoeboids.

The brothers Hertwig have published a series of contributions to the solution of the problem, and have embodied their general results in an article entitled the 'Coelomtheorie.' As we have shown, their predecessors had pretty well established the necessity of regarding the mesoderm as consisting of two parts, — *first*, the paired epithelial portion derived from the entoderm, forming the lining of the body-cavity, and giving origin to the peritoneum, muscle-plates, genital glands, etc.; *secondly*, scattered cells, giving origin to the connective tissue, the endothelia, vessels of the circulation, the blood, and lymph. These conclusions, however, had never been systematically collated and coherently presented. The brothers Hertwig performed this task with characteristic ability and success. Guided by their own important original researches on several animal types, and utilizing the results of others, they succeeded in demonstrating the prevalence of the same composition of the mesoderm in the

[1] Minot: Preliminary notice of certain laws of histological differentiation. *Proc. Boston soc. nat. hist.* xx. 207.

majority of animals. Their own most important addition to our knowledge appears to me to be their analysis of the morphology of muscular tissue, by which they removed the most important difficulty against the final acceptance of the generalization. While we thus recognize the great services rendered by the brothers Hertwig, we are impelled also to express our regret that they have not been more generous in their acknowledgment of the achievements of previous investigators; for their theory was mainly the result of a judicious combination of what had been before published. To them belongs the merit of ripening the fruit which was already formed.

To the mesamoeboid portion of the mesoderm the Hertwigs gave the very appropriate name of 'mesenchyma.' For the epithelial portion no satisfactory name has yet come into use: therefore I venture to propose 'mesothelium.'

In applying this generalization which we have been considering to vertebrates, difficulties and objections were encountered. To set these aside, Professor Oscar Hertwig has published two special researches, the second of which appeared recently, and is reproduced in abstract below.

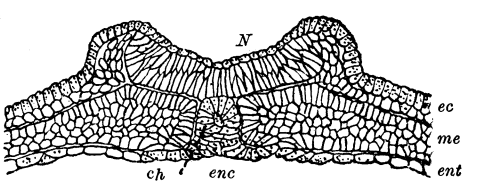
In this review, only a few salient points of the history of this most important of recent embryological discoveries are given; but I cannot close without a strong expression of my regret at being unable to notice many valuable contributions to the subject, — a pleasure which the limited space at my disposal compels me to unwillingly forego.

In continuation of the extended researches on the origin of the mesoderm previously given to the world by his brother and himself, Oscar Hertwig now publishes the results of his investigations on the development of the middle layer in the frog, adding a discussion of its origin in other vertebrates. The early stages in the frog are described with great minuteness, and with far less concision and directness than we should have anticipated in any of Professor Hertwig's writings.

The essential points brought forward are the following. In the first stage, while the blastopore still appears as a round white spot, the primitive *darm* (urdarm) has the well-known form. Its inferior and lateral boundaries are the cells of the entoderm; but along the dorsal line the cells offer a different histological character, being pigmented, and consisting of three or four rows of small cells. In Triton, however, there is a single row of high cylinder cells. This dorsal band includes the *anlage* of the notochord, and is named by Hertwig 'chorda-entoblast.' Around the blastopore the mesoderm is already present, forming a paired extension running forward as a lateral mass on either side, and a median division lying below the blastopore. Around the edges of the blastopore all the layers are united: throughout the remainder of its extent the mesoderm is separated by a narrow space from both ectoderm and entoderm. The mesoderm and the chorda-entoblast are both histologically similar to the ectoderm; and Hertwig, on that account, believes they are both derived from the outer germ-layer. (This conclusion we think is founded upon an insufficient basis.)

In the next stage the blastopore remains merely as a white point, and the medullary folds and median dorsal furrow appear. The notochord is developed under the dorsal furrow as a thickening of the median portion of the chorda-entoblast, which butts against the ectoderm, so that the mesoderm is excluded from the axial line. Ultimately the lateral portion of the chorda-entoblast enters into the formation of the intestinal wall; but in Triton the whole of this peculiar band is changed into the chorda, which, being formed by an invagination, exhibits a slit in transverse sections of early stages. No such slit is seen in frogs. There is a fold formed at the lateral junction of the chorda-entoblast with the rest of the entoblast; and along that fold the entoderm is fused, without demarcation, with the mesoderm. Around the blastopore the three layers still present essentially the same arrangement as before; the mesoderm has grown out around the whole ovum, except a small area on the ventral side, where the ectoderm and entoderm (yolk) are in immediate contact.

In the next stage, when the whole length of the broad medullary groove is clearly marked out, and indeed in later stages also, the absolute independence of the notochord of the mesoderm, and its development out of and gradual separation from the chorda-entoblast, are to be clearly recognized (see the accompanying figure). In the region of the blastopore, where the mesoblast is continuous with the other layers, there are two projecting lips, on one side formed by the entoderm proper, on the other by the chorda-entoblast. These lips enclose a fissure between them, which is a small evagination of the enteric cavity into the mesoderm.



Frontal section through a frog ovum in which the medullary ridges have begun to appear. *Ent*, entoderm; *enc*, chorda-entoblast; *ch*, notochord; *me*, mesoderm; *ec*, ectoderm; *N*, nervous system.

In a later stage the anus is developed *behind* the blastopore as a simple ectodermal invagination, the bottom wall of which breaks through. No such relations between the germ-layers have been found here, or elsewhere, as around the blastopore.

The points, then, of special importance, brought out by Hertwig, are, 1°, the existence of the median dorsal

band of cells, the chorda-entoblast, entering into the formation of the entodermic wall, but resembling in character the ectodermal cells; 2°, the development of the mesoderm as a paired outgrowth from the blastopore. In part second of his paper, Hertwig reviews the published investigations on the embryology of other classes of vertebrates. He accepts the homology of the primitive streak in Amniota with the blastopore. He is fairly successful in proving the same relations of the germ-layers to exist in all vertebrates. He also discusses the various objections advanced against the *coelomtheorie*, according to which the mesoderm is an epithelial layer, bounding the body-cavity. He draws from his observations and arguments the following conclusions: 1. The mesoblast grows as a continuous mass from acknowledged epithelial layers; 2. In all vertebrates there early appears a fissure in the mesoderm, limited parietally and viscerally by epithelium, as can be especially well seen in elasmobranch embryos; 3. From this epithelium are derived true epithelial membranes in the adult, from which are developed the peritoneum, kidneys, sexual glands, etc.; 4. The primitive mode of origin of the mesoderm is probably that described by Kowalevsky and Hatschek in Amphioxus, —an invagination of an epithelial membrane (entoderm); 5. In the true vertebrates the mesoderm grows out as a solid mass, in which the fissure appears later. This must be regarded as a secondary modification, for we frequently find hollow organs making their first appearance as solid *anlagen;* e.g., the central nervous system of teleosts, many sense-organs, and most glands. These considerations lead collectively to the final conclusion that the mesodermic plates are morphologically epithelial evaginations homologous with those of the invertebrates.

Charles Sedgwick Minot.

ACOUSTIC ROTATION APPARATUS.

In a recent number of the *Zeitschrift für instrumentenkunde*, Dr. V. Dvořák gives an account of the various forms of apparatus which have been devised to show attraction or repulsion due to sound-waves, or to gain a continuous rotation.

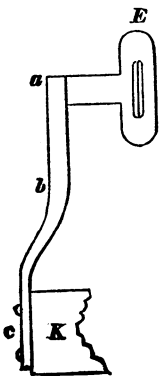


Fig. 1.

Such experiments require a good volume of sound for success. That this may be obtained, not only should the tuning-fork be in accord with the resonator-box on which it is placed (the most convenient form of sounding-body for the purpose), but also the elastic system, consisting of tuning-fork and box, should be capable of vibrating in unison with the fork and the air in the resonator. The three sounds are called the fork, the air, and the wood tone. In order to get the last, the resonator should be stuffed with cotton-wool, and a piece of cork put between the prongs of the fork; then, by rapping on the top of the fork, the whole system is vibrated very much as it would be by the up-and-down motions of the lower part of the fork when free. By cutting away the walls of the resonator to make them thinner, the system may readily be brought to the right pitch. In most of the resonators in common use the wood tone is too low, owing to the wood being already too thin.

The fork used by Dr. Dvořák was *G*, having 392 vibrations per second. It weighed 265 grams. As a resonator, an ordinary pine box was used, about 13.5 cm. long, 11 cm. broad, and 10.5 cm. high. In one side a round hole was cut, large enough to make the air tone of the right pitch. The wood was 8 mm. thick. From the top and bottom it was shaved off for the purpose explained above. The dimensions of the box were entirely accidental, but proved to be good.

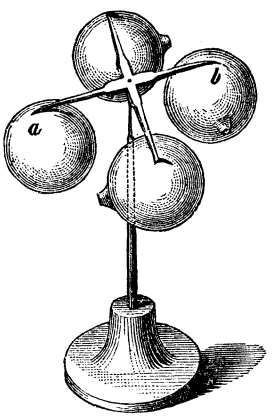


Fig. 2.

By using an electro-magnet to keep the fork in continuous vibration, the results are naturally more sure. The form of magnet which has proved satisfactory is shown in fig. 1. *E* is the magnet, with a core made of iron plates. This magnet is placed between the prongs of the fork, and is held by the wooden arm *a c*, to the lower end of which is fastened the resonator *K*. At *b* the arm is bound to a firm support, so that the system of fork and resonator is perfectly free.

The resonator-wheel (fig. 2) is the first form of rotating apparatus described. It consists, as shown in the illustration, of four glass resonators on the four arms of a wheel. For a fork of 392 vibrations, the spheres should be about 44 mm. in diameter, with openings 4 mm. across. Rotation was obtained with the fork 40 cm. away.

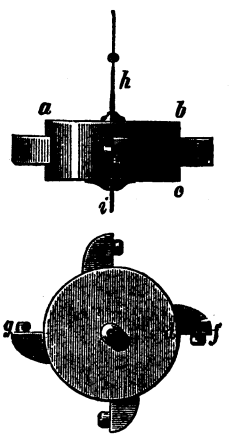


Fig. 3.

As a modification of this wheel, a rotating resonator (fig. 3) may be made of a flat cylindrical pasteboard box, having a number of side-openings, each ending in a short piece of tubing of size to make the resonator respond to the fork. When suspended by a silk thread, *h*, such a resonator

can be easily put in rotation ; *i* is a needle to rest in a hole in a piece of lead, to prevent oscillation. The dimensions given are: *a b*, 70 mm.; *b c*, 36 mm.; *d f*, 19 mm. The tubing openings were 8 mm. long and 6 mm. in diameter.

The sound-radiometer (fig. 4) is readily made. In cardboard about 8 mm. thick, holes are punched at intervals of 6 mm. with the punch of the form shown at *A*. When prepared in this way, the cardboard will be repelled if presented to the resonator with the small ends of the holes toward it, and attracted when reversed. To make these effects more marked, the punch and die shown at *B* and *C* may be

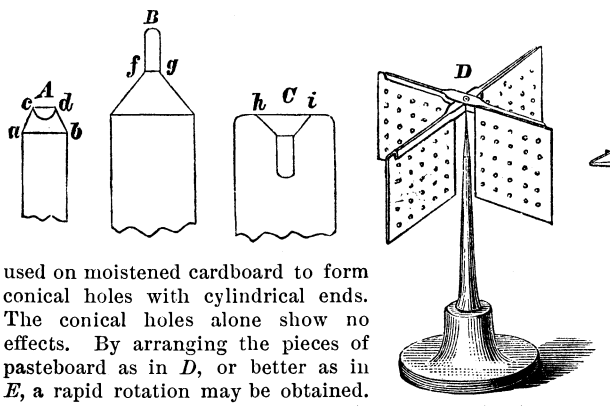


FIG. 4.

used on moistened cardboard to form conical holes with cylindrical ends. The conical holes alone show no effects. By arranging the pieces of pasteboard as in *D*, or better as in *E*, a rapid rotation may be obtained. The apparatus shown in fig. 5 is called a sound-wind-mill. A Helmholtz resonator, *a b*, is placed before the opening of the box-resonator. Out of the smaller end, *a*, a stream of air will be blown when the fork is vibrated, and its existence shown by the rotation of the windmill, *h k*. The dimensions of the Helmholtz resonator for *G* are : diameter, 80 mm. ; the opening at *b*, 16 mm. ; at *a*, 2 mm. This last is very important. It seems odd that the resonator with two openings may be replaced by such as shown at *R* with only one. The opening may face in any direction, provided the windmill is suitably placed, and still the mill will turn. When the opening is turned toward the resonator-box, the distance between the

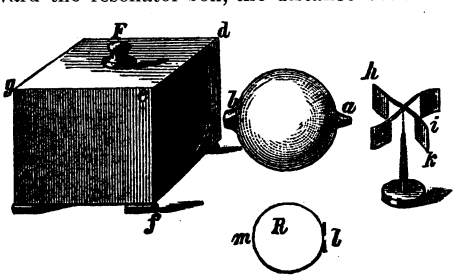


FIG. 5.

resonators may be as great as half a metre. The dimensions and form of the ball are important. A suitable one may be made by grinding off the top of a glass globe 50 mm. in diameter, and covering the opening with a very thin metal plate in which there is a hole 3.5 mm. across. The puffs of air coming from the opening *l* are vortex-rings, which may easily be shown by filling the ball with smoke.

By putting one of the wings of the sound-radiometer before the box-resonator with the larger ends of the holes facing it and at a distance of 2 cm. from it, the mill may be made to rotate by the puffs of air coming through the holes, which should be numerous.

AURORAL EXPERIMENTS IN LAPLAND.

MR. J. RAND CAPRON gives a brief account (*The observatory*, Sept.) of Professor Lemström's experiments, quite similar to that which has already appeared in SCIENCE. He thinks that Professor Lemström's conclusion, that the height of auroras "has been generally overestimated may probably open a lively discussion, as undoubtedly his dictum will that 'measurements of an aurora on a long base must be erroneous, as the observers never see the same aurora.'" He thinks, too, that the relation Professor Lemström believes himself to have proved, between movements of atmospheric electricity and the 'variations of the magnetic elements,' may be only apparent.

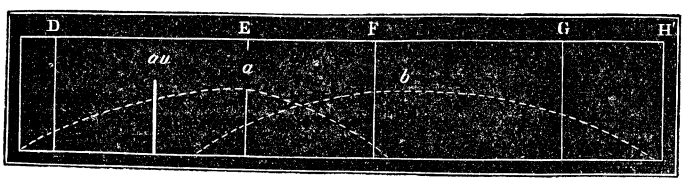
Mr. Capron believes that the experiments described did "collect and make apparent to the eye a true auroral glow, its spectroscopic character being at the same time tested and defined by experienced observers." He adds, "Yet one cannot help feeling something of regret that, if only for further assurance, the wave-length of some one line seen was not (as far as we are aware) absolutely determined, on some occasions at least, and that the observations appear to rest only on a small instrument presumably without scale."

Mr. Capron's article is important mainly for calling renewed attention to the phosphorescence, or fluorescence, theory of the principal (yellow-green) line of the aurora spectrum. This theory, first proposed by Angström, was advocated in the *Philosophical magazine* for April, 1875, by Mr. Capron, who is inclined to attribute the line to phosphorescence, apparently on the following grounds: 1°. The 'phosphorescent appearance' of the aurora; 2°. The fact that phosphorescence is capable of giving quite sharply defined spectral lines, as shown by his observations with a phosphorescent vacuum tube; 3°. The fact that the auroral line belongs to 'the principal region of phosphorescent light;' 4°. 'The observed circumstance that the electric discharge has a phosphorescent afterglow.'

Mr. Capron observed, moreover, that the auroral line lies in the region of a certain bright band in the spectrum of a phosphoretted hydrogen flame, though somewhat nearer the red end of the spectrum than is

the brightest part of this band, as shown in the accompanying figure.

"In this diagram (of a normal spectrum), curve *a* [which Mr. Capron calls the phosphorescence curve] is deduced from the spectrum of phosphoretted hydrogen, curve *b* from Professor Angström's spectrum of the violet pole of air-vacuum tubes; *a u* is the principal auroral line." This figure is apparently intended



to represent the facts under ordinary laboratory conditions; but Mr. Capron states, that according to Lecoq de Boisbaudran, when the flame of phosphoretted hydrogen is artificially cooled, the bands of the spectrum become intensified, and in such a way that the brightest portion of each band is shifted toward the red end of the spectrum. Mr. Capron appears to think, that, under the intense cold of the auroral regions, one of these bands might become the line *a u*.

E. H. HALL.

LETTERS TO THE EDITOR.

Secular increase of the earth's mass.

THE thoughtful and suggestive researches of Ebelmen and T. Sterry Hunt, on the chemical and geological relations of the earth's atmosphere,[1] have led me to some further deductions, which seem to increase the interest in this field of inquiry. The general tendency of these studies is to show that the chemical transformations in progress upon the earth involve the fixation of a larger volume of atmospheric constituents than could probably have ever existed in the atmosphere at one time, and that they must consequently have arrived from interplanetary space.

1. *The carbonates.* — It is generally agreed, as first shown by Hunt, that the carbonates of lime and magnesia have arisen chiefly through the interactions between carbon dioxide of the atmosphere, the decomposing silicates of the earth's crust, and the chloride of calcium of the ocean. The carbon dioxide has therefore been contributed by the atmosphere. To what does this contribution amount? We may assume, without material error, that the carbonates here in question are all calcium carbonate, with a specific gravity of 2.72. Then, the mean pressure of the atmosphere being about 14.7 pounds avoirdupois on a square inch, a little calculation shows that an amount of carbon dioxide in the atmosphere sufficient to double its pressure would yield only 8.627 metres of limestone. An amount sufficient to cause a pressure of 80 atmospheres would suffice for the formation of limestones equal to only a fortieth (.02265) of the hundred thousand feet which, for this purpose, may be assumed as the thickness of the stratified rocks. But a pressure of 80 atmospheres at a temperature of 30° C. produces liquefaction of carbon dioxide. The actual proportion of limestones and dolomites in the earth's crust is about one-eighth, as I have shown by recent studies. This amount would yield, by the liberation of all its carbon dioxide, a pressure of 441.6 atmospheres. If we consider the limestones and dolomites formed since the period of the coal-measures, the proportion required to yield, on the liberation of its carbon dioxide, a pressure of 80 atmospheres, would be only a twenty-second (.04469) of all the post-carboniferous strata. The actual proportion is about one-eighth, as for the whole stratified crust; and this would yield sufficient carbon dioxide to cause a pressure of 223.8 atmospheres.

It is not credible that such amounts of carbon dioxide have ever existed in the atmosphere at one time. During the larger part of the aeons of carbonate formation, animal life has existed in great abundance upon the earth; and this would have been impossible with 200 to 400 atmospheres of carbon dioxide present. As the proportion of this gas in the existing atmosphere is only 4½ parts in 10,000 by weight, 200 atmospheres of the gas would be 444,000 times the present proportion. It is scarcely more credible that the pressure of 200 to 400 atmospheres would have been compatible with either vegetable or animal organization, so similar as it was fundamentally to modern organization. As this large amount of carbon dioxide cannot be supposed derived from the earth's crust, it must have been derived from interplanetary space. This would imply an addition to the earth's mass of .0003806, which is about $\frac{1}{2636}$ part of the present mass.

2. *The kaolinization of felspars.* — Hunt has shown that the kaolinization of a layer of 51.66 metres of orthoclase, or its equivalent of quartzo-felspathic rocks, would result in 23.7 metres of kaoline, and would use up 10,333 kilograms of carbon dioxide per square metre of surface. This is the weight of the atmosphere. Now, the whole amount of felspathic decomposition during the sedimentary ages must much exceed 500 metres in vertical thickness of kaolinic deposits. But 500 metres of kaoline represent 21.1 atmospheres of carbon dioxide; and, assuming the mass of the atmosphere at $\frac{1}{1\,\!2\,\!0\,\!0\,\!0\,\!0\,\!0}$ in relation to the earth, the carbon dioxide fixed in the processes of kaolinization would be .0000175826 of the total mass of the earth.

3. *Decay of hornblende, pyroxene, and olivine.* — According to Hunt, the decay of 10⅓ metres of such minerals, or their equivalents in hornblendic and pyroxenic rocks, would yield carbon dioxide equal to 1 atmosphere: hence, if the earth's crystalline rocks have afforded 500 metres of hornblende and pyroxene, they must have fixed 48.387 atmospheres of carbon dioxide. This, in relation to the earth's mass, is 0000403209.

4. *Conversion of ferrous into ferric oxide.* As Ebelmen states, the conversion of 21,357 kilograms of ferrous oxide into 23,750 kilograms of ferric oxide would consume the whole of the 2,376 kilograms of oxygen in the atmosphere (more exactly, 1.007 atmospheres) covering a square metre. If, then, we suppose the existence over the earth of 1,000 metres of sediments derived from the decay of crystalline rocks containing only one per cent of ferrous oxide, weighing, according to Hunt, 25,000 kilograms, this is 1.052 times the amount requisite to fix the oxygen in 1.007 atmospheres; that is, 10 metres of ferric oxide represent the fixation of 1.059 atmospheres of

[1] See a memoir by T. Sterry Hunt in *Amer. journ. sc.*, May, 1880, where references are given to numerous other publications.

oxygen. This, in relation to the earth's mass, is .0000008825.

5. *Unoxidized carbon.* — This occurs not only in coal-beds, but in pyroschists and petroleum. We find that the oxidation of a layer of carbon 0.7123 metre in thickness would use up all the oxygen in the atmosphere. A layer 2.252 metres thick, and having a specific gravity of 1.25, if converted into carbon dioxide, would exert a pressure of one atmosphere. This would amount to 2,267,000 tons of 2,240 pounds each on a square mile. Mr. J. L. Mott calculates that the amount of unoxidized carbon per square mile cannot be less, and is probably many times greater, than 3,000,000 tons. If we adopt this determination, it will imply a depth of 0.982 metre, and the proportion of the earth's mass will be .00000036318. This is the amount of carbon dioxide which must be decomposed to yield a layer of carbon over the earth only a trifle over three feet in thickness, while it is probable that the carbonaceous deposits of the earth's crust exceed this. Now, it will hardly be maintained that the uncombined carbon of the earth's crust was derived from any other source than the atmosphere, and mostly through the agency of vegetation. The earth's atmosphere must therefore have contained all this amount of carbon dioxide. With the fixation of the carbon, the freed oxygen, it may be said, might have been employed, as far as it would go, in the formation of ferric oxide, whose demands upon the atmosphere have just been computed; but, as it would only satisfy $\frac{1}{3\,0\,9}$ of those demands, it is hardly necessary to consider the question.

6. *Meteoric contributions.* — If, as commonly assumed, 400,000,000 meteors enter our atmosphere daily, an average weight of ten grains each would amount to a yearly addition of 93,170 tons. This, in 100,000,000 years, would amount to .0000000001542 of the earth's mass, and would form a film .292, or nearly $\frac{2}{7}$, of an inch thick, having a density of 2.5.[1]

Gathering together these various contributions to the earth's mass during 100,000,000 years, we have the following: —

1. CO_2 represented by the carbonates . . .	.0003806
2. CO_2 fixed in kaolinization of felspars . .	.0000175826
3. CO_2 fixed in decay of hornblendic and augitic rocks	.0000403209
4. O fixed in conversion of ferrous oxide . .	.0000008825
5. CO_2 represented by uncombined carbon .	.00000036318
6. Meteoric contributions	.0000000001542
Aggregate	.0004397507 22

This is an addition of $\frac{1}{2\,4\,1\,6}$ to the earth's mass; and, in the present state of knowledge, it does not appear on what grounds assent can be withheld from the result, or some result of similar purport. It must be left with the astronomer to determine what relation this increase may sustain to the moon's acceleration in its orbit and to other phenomena. It may be noted, however, that the remote secular recession and retardation of the moon, which G. H. Darwin has recently brought to view, would have been delayed by the cause here considered, and the time required for the attainment of the moon's present relations would have been prolonged, but to what extent remains to be determined.

The evidences disclosed by these recent researches, of the slow accession of gaseous and solid matters to the earth, possess a profound interest. It would almost seem that the earth's atmosphere is only so much of the intercosmical mixture of gases and vapors as the earth's mass is capable of condensing around it, and that the proportions of these gases are determined separately, each by its own weight and elasticity and by its relative abundance in space; so that, as any one becomes diminished by fixation in the planetary crust, new supplies arrive to keep the ratio constant. As under this view it is apparent that an atmosphere should be accumulated around the moon, even after the saturation of the pores of its rocks, it may be said that the moon's mass and volume are such that her atmosphere would possess only $\frac{1}{3\,6}$, or, according to Neison, $\frac{1}{5\,0}$, the density of the earth's atmosphere; and this degree of tenuity might reduce the lunar atmospheric refraction to the small value actually observed.

ALEXANDER WINCHELL.

[1] The value given for this film in a note, p. 14, in my 'World-life,' should be multiplied by 365¼.

Regulation of electromotive force.

In one of the articles — the first, I think — recently published in SCIENCE (ii. 642) upon the subject of the electric light on the U. S. fish-commission steamer Albatross, the writer tells us that the brilliancy of the Edison incandescent lamps is kept constant, when other lamps upon the circuit are lighted or extinguished, by placing an adjustable resistance in the circuit of the field-magnets of the dynamo-electric machine, 'whereby the internal and external resistances are balanced.'

The importance of the subject scarcely seems to warrant any more space being devoted to it than already has been. But the point that I bring up is not an immaterial one, such as whether the engine is on the port or the starboard side of the vessel: it is a question which involves interesting and important physical principles.

The reason an adjustable resistance is required in the field-circuit of an Edison dynamo, in order to maintain a steady incandescence of the lamps, results from the fact that the armature has some resistance. This resistance is quite small, to be sure, but it has a considerable effect, nevertheless.

In order that a multiple arc system should be perfect, so that the dynamo or generator would require no adjustment or regulation when lamps were turned on or off the circuit, it would be necessary that this generator should have absolutely no resistance: for, if it were possible to reduce the internal resistance to zero, then there would be no fall of potential within the machine itself; that is, the fall of potential would all be in the external circuit, and the difference of potential between the poles of the generator would be equal to the total electromotive force of the circuit. In that case, all that is necessary is to keep the electromotive force constant; and then it follows, that any number of the lamps in the system may be lighted or put out without producing any fluctuation whatever in the light of the other lamps, because the incandescence of a given lamp depends only upon the electromotive force with which it is supplied. Now, we know that the electromotive force generated by a dynamo is constant, provided that the speed of rotation of its armature, and the intensity of the field-magnetism, are kept constant. The armature is maintained at a constant speed because it is driven by a steam-engine furnished with a governor, the function of which is to secure a constant speed;[1] and the field-magnets have a constant strength because the current which excites them is constant, since this current, like the current in the lamps, is produced by an electromotive force, which, by hypothesis, is constant.

Let us now consider the case where the resistance of the armature is not zero (to which, of course, it

[1] The speed would remain constant, but the *power* required would increase with the number of lamps in circuit.

never could be reduced), but is some small fraction of an ohm (say, .2 ohm), and suppose that there is a single lamp of 140 ohms' resistance in circuit, and that the electromotive force is 100 volts: then $\frac{140}{140.2} \times 100 = 99\frac{9}{7}$ volts will be the fall of potential in the lamps, and only $\frac{1}{7}$ volt in the armature. But suppose that there are 70 lamps of the same resistance (140 ohms) in circuit, instead of a single one: then the external resistance will be reduced to $\frac{140}{70} = 2$ ohms, and the fall of potential in the lamps will only be $\frac{2}{2.2} \times 100 = 90\frac{10}{11}$ volts, and $9\frac{1}{11}$ volts in the armature.

Thus we see, that, when the number of lamps in circuit is increased from 1 to 70, the difference of potential available in the lamps is decreased from $99\frac{9}{7}$ to $90\frac{10}{11}$ volts, a reduction of almost one-tenth; in consequence of which the candle-power of the lamps would be lowered at least one-third, and probably one-half. Of course, variations in the brightness of the lamps of one-third, or one-tenth, or even one-twentieth, would not be permissible: therefore, in order to maintain the required steadiness of the light, it is necessary to raise the electromotive force of the dynamo as more lamps are put on, and to lower it as lamps are taken off. This is done by increasing or diminishing the strength of current in the circuit of the field-magnets by means of a resistance-box interposed in the circuit. This regulation of the electromotive force of dynamos by controlling the resistance of the field-circuit may be, and in fact has been, made automatic; but up to the present time it has more generally been done by hand.

In what has gone before, I have said nothing about the resistance of the conductors which convey the current from the dynamo to the lamps. The effect of the resistance of any conductor which is *common to two or more lamps* — one of the main conductors, for example — is precisely the same as the effect of the resistance of the armature, which has been discussed above; but when a conductor supplies only a *single* lamp, then it does not have this effect. Of course there is a loss or fall of potential due to the resistance of the individual conducting-wires of each lamp; and of course the fall of potential in the lamp itself, and consequently its brightness, are thereby reduced. But this resistance does not introduce any *irregularity:* its effect in diminishing the light of the lamps is constant.

Let us suppose that a conductor having a resistance of 140 ohms feeds a single lamp of 1.4 ohms' resistance: then the loss in this conductor will be 1% of the useful fall of potential. But suppose that we now put 10 more lamps in circuit: then the loss in the conductors will be increased to over 10%; and assuming the useful fall of potential to be 100 volts, with a single lamp in circuit, it will only be about 90 volts with 11 lamps. The candle-power of the first lamp would drop at least 25% or 30% when the other 10 lamps were added. Thus it is, that, in a multiple arc system of electric lighting, any resistance which is common to a number of lamps, whether in the armature or the conductors, causes fluctuations in the light of the lamps when other lamps are put on or off; whereas the resistance of the individual conductors of each lamp produces a loss of potential which is a constant fraction of the total potential, but does not introduce any unsteadiness.

F. B. CROCKER.

Osteology of the cormorant.

With respect to Mr. Jeffries' criticism (SCIENCE, ii. 739) of my paper on cormorants, I beg to say that the occipital style of the cormorant is not an ossification in the tendon of any muscle; that he is entirely wrong in his view of the homologies of what I call a patella; and that, furthermore, I find myself misquoted more than once.

R. W. SHUFELDT.

A dog plans and executes with reference to the future.

Six weeks ago Prof. J. B. Thayer of this place returned from Ree Heights, Dakota, bringing with him one of a litter of eight pups raised by a slut of the setter breed. The story which he relates to me of this pup's mother is, it appears to me, worthy of record.

The good mother appears to have discharged her arduous duties as only a mother can, and arrived with her eight babes at the time when they should be weaned. At this juncture, judging from the events reported to have followed, she seems to have conceived the idea that too many dogs were occupying the same claim, and that a distribution was desirable. Accordingly, she started one morning with three of her pups, and was observed by Miss Rosa Cheney, now of this place, running in the road toward their claim at a rate which made it impossible for the pups to keep pace with her. The dwelling where she lived, and another shanty on the adjoining corner of another claim, are situated one mile and three-fourths from the dog's home. The mother reached the claims in advance of her babes, but no sooner had they arrived than she hurried on at her best pace. Miss Cheney reports that "the puppies came up all out of breath, and apparently too tired to continue; but the smallest of the three followed on." Another claim was reached three-fourths of a mile beyond; and here Miss Cheney observed the mother stop until her panting babe came up, when she immediately set off again. A quarter of a mile beyond the last claim, the mother was observed to make a third halt as before, and then to pass on beyond the range of vision, towards Ree Heights, with the puppy still following her. Two days later the persistent mother, with her more persistent babe, was observed coming back; and Miss Cheney tells me that the little puppy appeared almost dead from fatigue.

Some days later the dog led off two more of her pups, and succeeded in leaving them both; but in the mean time the two puppies left the first day were returned. A pup was also left at Professor Thayer's claim, but was returned, and exchanged for another. Both Professor Thayer and Miss Cheney assure me that other efforts of the same kind were made by this dog, but with what results they are unable to say.

After the puppies had been distributed, they were not forgotten; for the old dog used often to go and play with them. Professor Thayer mentions one instance of her coming and playing with the puppy left at his claim until it was very tired, when she lay down by the side of it; but, after it had gone to sleep, she quietly walked to the opposite side of the house, and then hurried away in the opposite direction from home for a distance of about forty rods, when she turned and went directly there, thus showing quite clearly that the thought of distributing her puppies was still uppermost in her mind.

What events may have awakened this desire on the part of the mother, or what reasons she had for her acts, we do not know; but in her own mind I have no doubt the case was urgent and the way clear, if

not also just. It would appear, not only that this dog must have thought her plan through, but that she must also have held it definitely in mind for several days while she executed it, thus indicating quite unequivocally, it seems to me, that one animal at least, ranked lower than man, possesses the power of looking into the future and of executing plans deliberately laid with reference thereto; "man is the only animal which has the power of looking into the future," to the contrary notwithstanding. F. H. KING.

River Falls, Pierce county, Wis.

Method for making electrical signals.

When I first became connected with the Alabama agricultural and mechanical college, the recitation signals were made by means of electric bells, one in

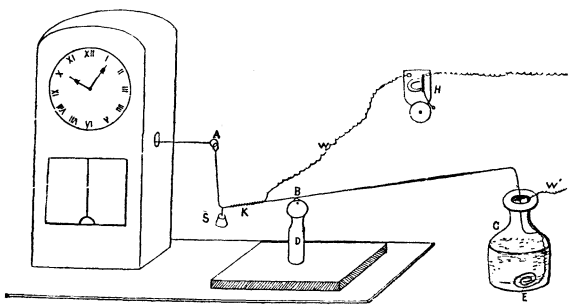


FIG. 1.

each professor's room. These were rung separately by pressing in succession as many push-buttons as there were bells. In order to complete the system, it was necessary to have one wire for each bell, and a return-wire running through the whole length of the system; and therefore only *one* bell could be rung at once. In the circuit there were twelve bells, about one-half mile of wire, and twelve one-gallon cells of Watson's battery. One of the cadets of the college was delegated to sound the signals at the end of each fifty minutes, which was the length of the recitation hours. Sometimes he would ring too soon, and at other times several minutes too late. This was frequently annoying, particularly when an interesting

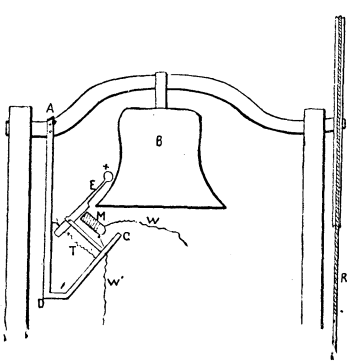


FIG. 2.

and important lecture was in progress. In the attempt to obviate this difficulty, the plan that I am about to describe was suggested to my mind.

We have an excellent compensated clock that can be made to strike twice any multiple of five minutes. After adjusting this clock so as to make it strike every fifty minutes, I insulated it on a square of plate glass. I then made an oblong opening in the side of the woodwork about one inch long. This slit was made on a line with the ball of the striker. Through this hole I passed a copper wire, and fastened it securely to the hammer of the gong. In the end of the wire outside of the clock I made a loop, as shown at *A*, Fig. 1.

A second wire, *A B C*, was attached to the first, as shown in the figure. A loop at *B* fits in a slit in the upright *D*, and a pin is inserted at *B* to hold the wire in position and at the same time allow the ends *A* and *C* to work up and down when the hammer of the clock strikes. The bottle *C E* is partly filled with mercury. From this mercury-cup a wire, *E W*, runs to one pole of the battery. The other pole connects at *K* with the wire *W*, after passing through all the bells of the system. *S* is a weight to counterbalance the arm *B C*. It will be readily seen that the outward stroke of the hammer will throw the end of wire *A B C* into the mercury, thus completing the circuit, and causing all the bells to ring. The blow of the hammer against the gong of the clock will raise the end *C*, and break connection. All but one of the bells must be single stroke: otherwise it will be impossible to obtain satisfactory results. By using one bell, with attachment for breaking and closing the circuit, the ringing will continue as long as the wire at *C* is in contact with the mercury.

The above system has been in operation for one year, and has given satisfactory results.

It has occurred to me that our large bell, weighing nearly two thousand pounds, can be made to strike the hours for the benefit of the town by placing it in the system just described, with the following adjustment. Procure a soft iron horseshoe magnet six or eight inches long, and secure it at *M* on the iron rod *A D C*, Fig. 2. This becomes magnetized when the clock completes the circuit. The armature *X Y* is attracted, and the ball *X* strikes the bell. The elasticity at *E* raises the ball immediately from contact, and allows a clear and distinct ring. The tension-spring *T* raises the armature from the magnet, and the current ceases to flow. If it is desirable at any time to ring the bell in the ordinary way by means of the rope *R*, the adjustment of the system may be sustained by making the supporting rod *A D C* secure to the bell-shaft at *A*, and thus permitting the magnet and fixtures to swing with the bell.

P. H. MELL, Jun.

Auburn, Ala.

GEIKIE'S GEOLOGY.

Text-book of geology. By ARCHIBALD GEIKIE, LL.D., F.R.S., director-general of the Geological survey of Great Britain and Ireland, etc. With illustrations. London, *Macmillan & Co.*, 1882. 971 p. 8°.

TEXT-BOOKS in science once held a rather low place in the estimation of scientific men. Labor of this sort was long relegated to the book-makers, who, copying statements and illustrations one from another, gave the student more of the errors of by-gone days than of the knowledge of their own. But in our own time all this has been greatly bettered. Now a man

of science is likely to look forward to text-book making as a source of honor as well as of remuneration; as a task that may not only help others on their way, but aid himself to a broader and more careful view of his own field of labor. The text-books of Lyell, Jukes, and Dana in geology are among the admirable works of these great authorities, and were doubtless helpful to them in their careers, as they have been vastly advantageous to those who have been trained by them. From a purely literary point of view, text-book making has no mean value to their makers. To collect the stores of learning of a science, to take that which has general value from the mass of details, to secure a due proportion and perspective to the parts of the work, — this is a task indeed.

Mr. Geikie has proven himself strong enough for this burden. His store of facts is far larger than has hitherto been gathered in any one book on geology. They show a large general reading, not only in the vast geological literature of his own island, in the making of which he has had a large share, but in the work done in other lands, — a praise that can be given to few of his countrymen. In his list of authorities he gives more names of scientific men of other countries than of British geologists; and this although he professedly desires to take his illustrations as far as possible from his own ground.

Besides the peculiarly large amount of well-gathered fact that marks this work, we may note among its peculiarities the considerably wider range in the method of treatment of the subject. In his first book he gives twenty-four pages to the cosmical relations of the earth, and under this heading presents the fullest and most satisfactory statement of the general condition and history of the earth as a member of the solar system that has yet been given in a popular treatise. With the same freedom of treatment, he does not hesitate to give a much fuller discussion of mineral veins than has hitherto found its way into any text-book. So, too, with those portions of the text that treat of river-action, volcanic phenomena, and the other leading manifestations of the geological forces. The author evidently feels a sense of freedom in making his book that is to be commended even if it gives him in the end near a thousand pages of text.

The paleontological part of the work is carefully done, but it is in the nature of the subject that it should be less commendable than the other parts of the book. There is a radical difficulty in treating paleontology, especially in its department of historical geology, in any text-book fashion. Even within the ample limits given by a thousand pages of print it comes down to a list of specific names that can only convey a meaning to the masters of the science; while the first principle of a text-book should be, that any statement should have a free comprehensibility within itself, without recourse to libraries or collections. Page after page of specific names hinders rather than helps the beginner.

This is the only criticism that can be made on the historic geology of the book, and it is one that lies against all the text-books that have thus undertaken to treat a subject that is so essentially unfit for this use. The essays on the divisions of the rock series are admirable. Especially to be commended is that on the old dispute concerning Cambrian and Silurian. It is pleasant to find a successor of Murchison in the directorship of the British survey who can do even-handed justice to the famous dead who fought this great battle over the division of the lower paleozoic section.

At several other points in the series of rocks we find an excellent spirit of discrimination applied to the problems of stratigraphic geology. We note the following. In discussing the relations of Permian to carboniferous rocks, the author notes the important fact, that, while in Europe there are discordances and sharp contrasts between the Permian and the carboniferous series, there is no such trenchant line in America. In the same spirit the indistinctness of the line between the triassic and the Jurassic series in North America is carefully pointed out. We find, also, that the doubt concerning the position of the Flysch series of the Alps is well presented; the ground being taken that the lower part of this series is upper cretaceous, the higher portions, eocene. This is the best brief presentation of this important problem that is known to the present writer. The only important exception that we can take to this admirable presentation of the stratigraphic problems concerns the author's general treatment of the triassic period. He notes that the European triassic series, with its reddish sandstones and shales, with connected gypseous and rock-salt beds, is essentially local in character, and that this aspect of the series cannot be expected in foreign lands. To this no objection can be taken; but he fails to assert the equally important fact, that reddish sandstones and shales have a singularly wide distribution in other lands. This general character of the trias constitutes it one of the most puzzling portions of the geological section, and

it should be given its due prominence in any general account of the series.

The last eighteen pages of the book are given to the chapter on physiographic geology.

This matter belongs in close relation to the earlier chapters of the book, and seems somewhat isolated in its position. It is not so completely treated as the other parts of the book; but it is, nevertheless, a fair condensation of the most material points of the subject. The illustrations of this subject are rather limited, but a diagram of the Colorado Canyon by Mr. Holmes (p. 923) gives a peculiar value to the set of diagrams.

It is hardly fair to quarrel with the title of so good a book, but it would have been better to have given it the name of a manual rather than a text-book. It is not fitted for the ordinary use of schools; being far too rich in matter, and calling for too much collateral knowledge for classroom work. It belongs in association with Dana's classic manual of geology. For American students it cannot replace that admirable book; but, taken along with the American work, it will give the student a very complete encyclopaedia of geologic science.

The book is fairly well made. The type is bolder-faced than in Dana's manual; so that the total amount of matter is about the same in the two books, despite the somewhat larger page of Geikie's volume. An admirable feature of the book is the free use of footnotes referring to authorities, which is a distinct advantage the book has for the student. The figures are well chosen, and finely serve their purpose; though there are not quite half so many as in Dana's work.

The index is voluminous and well made.

HAECKEL'S CEYLON.

Indische reisebriefe. Von ERNST HAECKEL. Berlin, *Paetel*, 1883. 13+356 p. 16°.

A visit to Ceylon. By ERNST HAECKEL. Translated by Clara Bell. Boston, *Cassino*, 1883. 8+337 p. 16°.

IN his 'Voyage of the Beagle,' Darwin has shown that an acquaintance with nature does not in the least detract from the interest of a traveller's adventures. Haeckel, in his new book on Ceylon, has still further given evidence that a love for nature's treasures adds an indescribable charm to one's wanderings in a strange land. In the 'Indische reisebriefe' we find a charming account of a scientific pleasure-excursion which the author made during the six months following October, 1881. The journey included a brief stay at Bombay, and a much longer series of travels through Ceylon, covering a space of four months.

Upon reading the book, the first impression we get is, that Haeckel must be a most pleasant travelling-companion, so delighted is he with every thing. He starts, he tells us, on a trip he has been longing for all his life, and evidently with the expectation and intention of having a delightful excursion. Nor will he allow any thing to frustrate his intention. It makes no difference where he is, or who are his companions: his good nature is unbounded. Every one, he seems to think, treats him with more than kindness; the roads he travels are models of comfort; and even the elements conspire in his favor. The country he passes through calls forth the whole wealth of the German language to find adjectives sufficient to express his boundless admiration. Officials give him every assistance; private homes open to him with the kindest hospitality; and even the natives take great interest in him, and are ever ready to give him aid which is at least kindly intended. When he establishes his laboratory at Belligam, he is supplied with servants, to whose excellency he can only do justice by naming one Socrates, and a second Ganymede. Belligam, the name of the town where he established his laboratory, means 'sand-village.' This name, however, does not suit Haeckel's general delight; and he calls it Bella gemma, considering it as 'a choice jewel in nature's casket.' An ordinary trip in the tropics is thus, by good nature and enthusiasm, transformed into a glowing journey through fairy-land. Indeed, one almost imagines, as he reads, that he has found an American advertisement of a pleasure-excursion. So full of pleasure and good fortune is the whole trip, that the reader soon grows weary, and wishes that some slight accident might happen, to break the monotony. It is certainly a relief to find the admission that the fauna of the island is disappointing; and we are quite reconciled to the fact, that the scientific laboratory was not quite so successful as had been hoped.

Haeckel's style in this book, as indeed in all his writings, is a most happy one. He gives what may be called a confidential description of nature where it is most lovable. The reader gets the impression that it is being given him in person by the author, for the purpose of enjoying once more the pleasures of the journey, and having a quiet laugh at the people. He cannot keep himself out of his descriptions, — indeed he does not try to do so; and what we see on every page is not a picture of Ceylon, but a picture of a man, making a journey through

Ceylon. He begins by telling us that he is getting to be an old man, and it is now or never with him as regards a journey in the tropics: but when, in the next breath, he informs us that his advanced years number eight and forty, we are quite amused at his premature old age. When he tells us, in the first chapter, how the Berlin academy refused to give him any aid on account of the challenge he had thrown to it on evolutionary speculations, we laugh with him. We see his amusement as he writes upon seeing wild apes for the first time: "Comparing them with the dirty and naked begging priests at our feet, they seemed to me a highly respectable ancestry for them." His German nationality, too, is ever apparent. Now we see it when he describes his German companions, or more frequently when he delights in his allusions to 'the indispensable black tail-coat and white necktie' of old England, or to the English 'chimney-pot' (*cylinderhut*), which he considers, 'of all head-coverings, the most hideous and insufficient.' He enjoys telling of English gluttony as compared with German temperance, of the Englishman's love for money with his exorbitant prices, and finally ends with the terse statement, 'Unsonst ist in Indien nur der tod.' But even his admiration for Germany does not prevent him from giving tribute to the faculty which England has exhibited as a colonizing power.

The scientific results of the Ceylon journey are not apparent. He travelled quite extensively through the island, continually swelling his collections, and finally established a rough laboratory at Belligam, where he worked hard for six weeks, filling his large cases with specimens from land and sea. But beyond the statement that the fauna of Ceylon agrees closely with that of the Philippine and Fiji group, the zoölogist gets little scientific knowledge. His account of the botany of the island is more extensive; but even this is largely made up of artistic descriptions of the magnificent vegetation which so vividly impresses a traveller in the tropics. That the journey was made by Haeckel is, however, sufficient proof that it was more than a pleasure-excursion. He brought back large cases of specimens, of which he says little, but which will, in years to come, undoubtedly be a source of much valuable information to the scientific world.

The book is not intended to be a scientific production, but rather a pleasant account of a naturalist's travels; and as such it is a success. A book of travels is usually dry and uninteresting after the first few chapters; for, however interesting new places may be to the traveller, to keep up a novelty in description soon becomes an impossibility. Haeckel has not entirely overcome this difficulty, but he introduces variety in the shape of personal anecdotes and observations. He is successful, too, in selecting most interesting points for description; and this, together with his boundless love for nature, which is so evident in every line, makes the closing chapters of his book much less wearisome than is usual with books of like nature. He reserves his account of the people until toward the end, and thus gives a series of bright chapters as the close of his stay at Belligam; and, by the continual introduction of people and incidents, he succeeds in keeping the reader's attention better than is customary. But, in spite of all, the last chapters of the book will invariably be glanced over in a hurried and cursory manner.

The translation by Clara Bell is on the whole good, though she has evidently been hard pressed to find expressions which will translate Haeckel's superfluity of adjectives. In some cases she seems to have been unable to find English expressions which give any idea of the German. One hardly gets the idea from the phrase 'worthy and fair reader,' which is conveyed by the German, '*Du, geneigter leser, und noch mehr, vererhte leserin.*' Though she has not followed the German very closely in her translation, yet she has succeeded in conveying to the English reader a tolerably good idea of Haeckel's flowing, free, and confidential style. The wonderful success of Haeckel's writings has proved that his method of writing and dealing with scientific subjects is a most attractive one; and this edition of his visit to Ceylon, partly on account of the freedom of the translation, but more largely because of the nature of the subject treated, will give to the English reader a better idea of his style of writing than any other of his translated works.

REMSEN'S THEORETICAL CHEMISTRY.

Principles of theoretical chemistry with special reference to the constitution of chemical compounds. By Ira Remsen. Revised edition. Philadelphia, *Henry C. Lea's Son & Co.*, 1883. 242 p. 12°.

In preparing this new edition of his little book upon 'Theoretical chemistry,' Professor Remsen has extended quite materially the second part, which treats of the constitution of chemical compounds, and which forms its most distinctive and attractive feature. Many of the alterations, however, will hardly be regarded as improvements by those who believe

that a clear and definite presentation of chemical theories is quite essential to their proper comprehension. While it is manifestly highly important that the student should not only be acquainted with the facts upon which chemical theories rest, but should also appreciate fully the nature of conclusions reached by inductive reasoning, still a constant reiteration of the doubts, uncertainties, or conflicting evidence, which surround the various hypotheses, seems to us ill advised in an elementary text-book.

Although structural chemistry in a certain sense is independent of the valence hypothesis, still this hypothesis was one of the earliest and most natural inductions resulting from the study of the constitution of chemical compounds, and is so interwoven with the present theories, that any attempt to exclude it rigorously from a discussion of the subject merely adds an unnecessary complication. We confess that we do not think the ordinary student will read with much interest the pages devoted to structural formulae, or 'proofs' of their correctness, if he chances to see beforehand the opening sentence of the retrospect which follows (p. 232).

"A study of the preceding chapters on constitution will show that no absolute meaning is to be attached to the word. Constitutional formulas are those which suggest certain reactions, and recall analogies. The formula CH_3-OH does not mean that hydroxyl (OH) is necessarily present in the compound, or that CH_3 is present, but that the different parts of the compound bear such relations to each other that when the compound is decomposed, it acts as if the parts were united as the formula indicates. The formula suggests possibilities; it may not represent realities."

If the author be correct, and "it cannot be denied that we are now in a period of chemistry which may fairly be called one of *formula worship*" (p. 100), it is very certain that formula worship has been of vastly greater service to chemistry than agnosticism is ever likely to be.

We fail to see that any advantage is gained by the introduction of new conventional signs in place of those already in common use, to represent the linkage of the carbon atoms in the olefinet and acetylen series (pp. 202, 206); nor can we understand why the double linkage of the nitrogen atoms, which the author apparently accepts, since he uses the old sign (=) in his formulae for the azo- and the diazo-compounds (p. 222), stands upon any more trustworthy experimental basis. Furthermore, we cannot help expressing our surprise that the author should have ventured the statement, "Of the substitution products of benzene, which contain three substituting groups, more than three varieties have been observed" (p. 208), which seems a bit of rashness hardly consistent with the caution elsewhere displayed.

THE CORNELL MATHEMATICAL LIBRARY.

Cornell university library. Special lists, No. 1. Mathematics. Ithaca, N.Y., 1883. 92 p. 8°.

THIS classified list of works, with index, includes some twenty-five hundred titles relating to mathematics, and such allied subjects as astronomy, engineering, and physics. These books form what is known, from the name of the donor, as the 'Kelly mathematical collection.'

An examination of the list shows that it consists of books actually purchased within the past few years, with good judgment, and a conscientious endeavor to cover, so far as practicable, the immense field of mathematical research, past and present, as evenly as possible.

It comprises, besides many rare and valuable works not readily accessible to American students, the collected works of the great masters of analysis, and the more important mathematical journals.

The mathematical capabilities of American youth are quite equal to those of Germany or England; but the facilities offered them by our universities for the study of this grandest of sciences are in general far behind those found abroad. When the professors and teachers of mathematics in this country shall themselves become lifelong cultivators of mathematical pursuits, and shall have the same average proficiency as those abroad, there will be no difficulty in accomplishing results in the mathematical training of college students fully equal to any attained elsewhere. But such professors and such students cannot be without libraries such as this is the beginning of. We can but express our deep satisfaction with this good work in the interest of sound learning.

WEEKLY SUMMARY OF THE PROGRESS OF SCIENCE.

MATHEMATICS.

Kummer's surface.—Professor Cayley, in a brief note 'on the sixteen-nodal quartic surface,' remarks, that Riemann's theory of the bitangents of a plane quartic leads at once to a very simple form of the equation of the sixteen-nodal quartic surface; viz.,

if ξ, η, ζ, denote linear functions of the co-ordinates (x, y, z, w), such that identically

$$x + y + z + \xi + \eta + \zeta = 0,$$
$$ax + by + cz + f\xi + g\eta + h\zeta = 0$$

(where $af = bg = ch = 1$), then the quartic surface,

$$\sqrt{x\xi} + \sqrt{y\eta} + \sqrt{z\zeta} = 0,$$

is a sixteen-nodal surface. Prof. Cayley has previously given the equation of this surface under the form

$$\sqrt{x(X-w)} + \sqrt{y(Y-w)} + \sqrt{z(Z-w)} = 0,$$

where $X = a(\gamma'\gamma''y - \beta'\beta''z)$, etc., and $\alpha + \beta + \gamma = 0$, etc.; the other relations being obtained by cyclical interchange of the letters, and by advancing the accents. The object of the present paper is the direct identification of these two forms of the equation of the surface. — (*Journ. reine ang. math.*, xciv.) T. C. [541

Elliptic functions. — M. Hermite has given a simple and direct demonstration of an interesting relation discovered by Prof. Cayley. The relation is as follows: if u, v, r, s, are four quantities connected by the relation $u + v + r + s = 0$, then we have —

$$-k'^2 \operatorname{sn} u \operatorname{sn} v \operatorname{sn} r \operatorname{sn} s + \operatorname{cn} u \operatorname{cn} v \operatorname{cn} r \operatorname{cn} s - \frac{1}{k^2} \operatorname{dn} u \operatorname{dn} v \operatorname{dn} r \operatorname{dn} s = -\frac{k'^2}{k^2}.$$

This remarkable relation is shown by M. Hermite to be easily derived by means of certain formulas which he has long used in his course in the Sorbonne. The formulas are those which give the decomposition into simple factors of the three quantities $\operatorname{sn} x \operatorname{sn}(x+a)$, $\operatorname{cn} x \operatorname{cn}(x+a)$, $\operatorname{dn} x \operatorname{dn}(x+a)$. The decomposition of the first of these products is a known fundamental relation between Jacobi's Z-functions: the decomposition of the other two products is given by M. Hermite; and by aid of them Prof. Cayley's formula is proved. — (*Acta math.*, i.) T. C. [542

ENGINEERING.

The two-cylinder compound engine. — Professor S. W. Robinson furnishes *Van Nostrand's magazine* a paper on the working of steam in this engine in its various forms, and traces the method of distribution in the two cylinders and the effect of such methods on the theoretical efficiency. He gives the general method of representing the action of steam graphically, and shows how diagrams made from the two cylinders are combined. The effect of the receiver is exhibited, and the result of the introduction of various conditions, as clearance, etc. — (*Van Nostrand's mag.*, Oct.) R. H. T. [543

Spherical steam-engines. — Messrs. Heenan & Froude of Manchester, G.B., recently exhibited at the Engineering and metal trades exhibition, London, their 'Tower' spherical engine, driving an Edison dynamo. The steam-cylinder is a sphere having two cylindrical projections cast upon it. Each of these carries a shaft, only one of which transmits power from the engine, the other having merely to guide the hinged piston nearest it. The pistons divide the interior of the sphere into four portions, which at times are four equal quadrants of the sphere, but which are capable of variation of volume with change of piston position; and, this being effected by the action of the steam which is let into the several spaces at proper times by the action of the rotating valves which are set in the cylindrical projections, the shafts are turned, and power is produced and transmitted to the mechanism of transmission.

The engine worked silently and well, and indicated 18-horse power at 600 revolutions per minute, with steam at 80 pounds ($6\frac{1}{3}$ atmos.). Its diameter was but 7 inches (17.8 centimetres). — (*London engineer*, July.) R. H. T. [544

Steel castings. — Mr. W. Parker has collected facts bearing upon the value of steel castings in marine-engine construction. He observes that forged iron shafts and other heavy parts are very unsafe, and that mild steel is taking the place of wrought iron for all such uses. About a hundred and twenty steel ships are in progress in Great Britain, constructed of low steel. The testimony of steel-makers and tests of the material show that steel castings can be made of homogeneous character and thoroughly reliable. Jessop & Co. use crucible steel for this purpose, and think that good castings can only be obtained with certainty by the crucible process. Spencer & Sons use both crucibles and the open-hearth process, and get equally good results from both. The Steel company of Scotland use the Siemens furnace and process, and adopt the silicide of manganese as a flux to insure soundness. The internal stresses due to variation in rate of cooling are avoided either by very slow cooling or by annealing. Pourcel of Terre Noire, France, tempers in oil, with, as is claimed, very great advantage. The tenacity is thus increased sometimes thirty per cent, and the elongation at rupture remains unreduced, while the grain of the steel is greatly improved. Sir Joseph Whitworth compresses his ingots of steel, while solidifying, by applying the pressure of a large hydraulic press. Messrs. Vickers & Co. make many large crank-shafts for steamships, adopting a mild steel of a tenacity of about fifty-five thousand pounds per square inch. The castings are improved by hammering or rolling, thirty per cent. — (*Scient. Amer.*, Oct. 20.) R. H. T. [545

CHEMISTRY.

(General, physical, and inorganic.)

Bleaching. — 'Oxygenated water,' a common name for peroxide of hydrogen, has within the last few years attracted a good deal of attention as a bleaching and purifying agent, and has been successfully employed as a substitute for chlorine. It is now stated that Mr. P. Ebell of Pfungstadt, near Darmstadt, has succeeded in preparing economically a product, pure, stable, and of constant strength, capable of being easily transported for long distances, and kept for years without losing its bleaching-properties. Among other applications of this product, that of the decoloration of animal fibres is the most important, as it does not contain some of the disadvantages of other bleaching-agents. For wool or silk, it is advisable, before bleaching, to cleanse the materials thoroughly, so as to eliminate all the greasy substances and impurities. For this purpose, Mr. Ebell recommends a

bath in a solution of five parts carbonate of ammonia to one hundred of water, this bath being followed by a soaping, and thorough washing with water. The bleaching itself is performed either by immersing the materials in the solution of oxygenated water, and leaving them there at a temperature of from 20° to 30° C., until the decoloration is complete, or the materials are impregnated, when they are wrung out and exposed in a room heated to about 20° C.: they are then left to dry. — (*Engineer*, July 20.) [546

Molecular volume of liquids. — In the determination of the molecular volume of liquids, R. Schiff proposes to make the observations at the boiling-point of the liquid and in a special form of apparatus. The latter consists of a small flask capable of holding about one hundred grams of mercury: it is drawn out to a narrow neck which is graduated to ten divisions, each of which corresponds to 0.01 of a cubic centimetre; and each of these divisions is divided into five parts, making each of the final divisions equal to 0.05 of a cubic centimetre. The volume is accurately determined by weighing the flask filled with mercury to the zero-mark. To determine the specific gravity of any liquid at its boiling-point, the flask is filled with the liquid, placed within a jacket-tube which contains a little of the same liquid, and the latter boiled until the liquid in the flask is heated to its boiling-point. By means of a capillary tube the liquid is withdrawn from the flask until it stands at the zero-mark, and the flask is corked, cleaned, allowed to cool, and weighed. The specific gravity of the liquid is referred to water at 4° C., and it may be calculated by means of the formula —

$$D^t_4 = \frac{P}{V_t\left(1 + K\,(t - 4)\right)},$$

in which P = the corrected weight of the liquid in the flask, V_t = the apparent volume which the liquid occupies at $t°$.

By this method the molecular volume of many of the paraffine and aromatic hydrocarbons, their halogen substitution products, alcohols, etc., were determined, and results were obtained which agreed closely with those of other experimenters. — (*Ann. chem.*, 220, 71.) C. F. M. [547

AGRICULTURE.

Aves guano. — A new phosphatic material under this name has lately been imported into Germany from the Aves Islands, in the Caribbean Sea, near the coast of Venezuela. Analyses of it by Märcker and by Heiden show it to contain about seventy-two per cent of calcium phosphate, four to nine per cent of calcium carbonate, seven per cent of organic matter, and twenty-five hundredths of one per cent of nitrogen. The material consists of a fine powder, with more or less fragments up to the size of a pea or larger. Among the coarser portions, shells and coral fragments are often found. The extent of the deposit is said to be great. — (*Biedermann's centr.-blatt.*, xii. 582.) H. P. A. [548

Comparison of nitrogenous fertilizers.—Märcker reports the results of pot-experiments by Albert on the relative value of various nitrogenous fertilizers for oats. Leather, either unprepared or fermented, gave as good as no increase of crop. The others ranged in the following order, the best being placed first: horn-meal, nitrate of soda, fermented dried blood, sulphate of ammonia, fermented steamed bone, steamed bone, dried blood. The horn-meal is prepared by treating horn-refuse with superheated steam. In previous experiments it produced almost as good an effect as nitrate of soda. It is to be observed, that several of the materials used contained other fertilizing ingredients than nitrogen, of whose possible effect no account seems to have been taken. An experiment in the following year with the pots manured with leather showed no noticeable effect from the latter. — (*Biedermann's centr.-blatt.*, xii. 584.) H. P. A. [549

Effect of fertilizers on composition of oats — In the experiments reported in the preceding abstract the composition of the oats produced by the aid of the various fertilizers was determined. Those manured with leather and those without nitrogen contained 8.7 % to 10.7 % of proteine; those manured with nitrate of soda and sulphate of ammonia, 11.2 % and 11.1 %; those manured with the blood or bone manures, 11.6 % to 13.6 %. The proportion of crude fibre and ash was greatest in those manured with leather and those without nitrogen: the others showed only slight differences. The nitrogenous manures delayed the ripening of the grain in some cases. Märcker divides them into three groups: 1°, those which allow the grain to ripen at the normal time, their nitrogen being assimilated during the early stages of growth (nitrate of soda, sulphate of ammonia); 2°, those which delayed the ripening somewhat (steamed bone, and the same fermented); 3°, those which delayed the ripening considerably, and rendered it irregular (horn-meal, dried blood). The last decompose slowly in the soil, and furnish a continuous supply of nitrogen until late in the autumn. — (*Biedermann's centr.-blatt.*, xii. 587.) H. P. A. [550

Nutritive value of amido-compounds.—Weiske has already shown that the asparagine which is found in various fodders, along with other amides and amido-compounds, can partially take the place of proteine in nutrition. Zuntz has repeated his observations on asparagine and other amides, with the same result. — (*Biedermann's centr.-blatt.*, xii. 602.) H. P. A. [551

Sunflower cake as fodder. — This material has been tested as fodder for milch-cows by Schrodt and von Peter with very favorable results. Slightly more milk was produced by its aid than by that of an equivalent quantity of palm-nut meal; and the proportion of fat in the milk was slightly increased, as has sometimes been the case in feeding palm-nut meal. No injurious effects on the health of the animals were noticed. — (*Biedermann's centr.-blatt.*, xii. 609.) H. P. A. [552

GEOLOGY.

Lithology.

Lithology of the District of Columbia. — According to Mr. G. P. Merrill, the prevailing rock of

this district is an extremely variable hornblendic, chloritic, or micaceous schist, sometimes somewhat gneissoid. This rock is used for building-purposes in its finer varieties, which are composed of quartz and biotite, with a silvery white mica, magnetite, apatite, etc. Besides the quartz and biotite, the coarser varieties frequently contain plagioclase, hornblende, chlorite, apatite, epidote, pyrite, magnetite, garnet, and rutile. The biotite is frequently more or less altered to chlorite, and contains apatite, magnetite, and sometimes infiltrated calcite. — (*Proc. U. S. nat. mus.*, vi. 159.) M. E. W. [553

The bismuth deposits of Australia. — These deposits are found in irregular quartz veins or 'reefs' in gray granite, and near its junction with the surrounding porphyritic and schistose rocks. The veins are composed of irregular segregations of quartz, holding bismuth, both native and as a sulphide, gold, molybdenite, smoky quartz crystals, etc. These veins occur only in circumscribed patches in the granite, which has here been decomposed to a soft, friable rock, the mica and felspar being much altered. The native bismuth occurs in irregular bunches and nests throughout the quartz, or in fissures traversing the veins. These bunches vary in weight from a half-pound to fifty pounds; and the metal is particularly found associated with and incasing the crystals of smoky quartz. Sometimes it is in needles in the quartz. The walls of the segregations are charged with from thirty to fifty per cent of oxide of bismuth for a distance from the vein of from eight inches to two feet.

Mr. Robertson, from whose paper the above account is condensed, states that the entire sale of bismuth has for years been monopolized by a few London brokers, "known as the 'Bismuth ring,' — a close and conservative institution formed for the purpose of controlling the supply and price of bismuth." The present consumption of the metal is about seventy tons yearly; and it is stated that these deposits could easily produce that at a small expense. In 1882 the market-price of bismuth was 6s. 8d. per pound in London. — (*Trans. geol. soc. Glasgow*, vii. 127.) M. E. W. [554

MINERALOGY.

Halite. — B. Wittjen and H. Precht have endeavored to find the cause of the blue color in some varieties of halite, and have arrived at the conclusion that it is dependent upon some optical phenomena, possibly connected with the presence of minute gas inclusions. — (*Berl. berichte*, xvi. 1454.) S. L. P. [555

Rubellan. — This micaceous mineral has been investigated by M. U. Hollrung, and shown to be very various in its properties. It occurs mostly as a decomposition product of magnesian micas. It is by no means homogeneous, and cannot be classed as a distinct mineral. By means of the microscope it could be seen that crystals of the ordinary biotite form were composed of lamellae of different degrees of decomposition, showing all stages from pure mica to wholly decomposed material. — (*Min. petr. mitth.*, v. 304.) S. L. P. [556

Parallel growth of zinc blende and tetrahedrite. — Specimens from Kapnik, Transylvania, have been studied by F. Becke. The minute crystals of tetrahedrite are deposited only upon the dull faces of the blende crystals, and are of a later growth. They have been deposited according to the following law: the principal axes of the two minerals are parallel, and the first or principal tetrahedron of tetrahedrite is parallel to the second tetrahedron of blende. The development of the tetrahedrite crystals is dependent upon their location on the blende, being most symmetrical if deposited on a dodecahedron face, and flattened if on a cubic face. A parallel growth of these two minerals has been previously noted, but with the first tetrahedron of tetrahedrite parallel to the first tetrahedron of blende. — (*Min. petr. mitth.*, v. 331.) S. L. P. [557

Iolite (cordierite). — A. von Lasaulx has described twin crystals occurring in a cordierite gneiss from Laacher See. Twins of this species are of unusual occurrence, and have been observed with the prism ∞P for composition face. The author finds, in addition to twins according to the old law, compound twins, part of the individuals being united according to the old law, and part according to a new law with $\infty \breve{P} 3$ for composition face. Twins united wholly according to the new law were not observed. — (*Zeitschr. kryst.*, viii. 76.) S. L. P. [558

GEOGRAPHY.

(*Arctic.*)

Arctic land. — F. Schmidt discusses the claims of different persons, and especially Wrangell, to the discovery of land north of eastern Siberia. Discovery is hardly the proper word to apply to the record of reports by the aborigines of that region. In fact, as Professor Schmidt admits, Wrangell had his doubts as to the accuracy of the report; and his opinion was expressed, sometimes with more, sometimes with less, confidence, at different times. The first civilized man to actually see what is now called Wrangell Island was Kellett, who called it Plover Island, and made a sketch of it from a long distance away, of which I have a copy, and which is stated to be characteristic by Capt. Hooper. The high land, with extensive peaks, described by Kellett, like the Pelly Mountains of the arctic coast, described by Dease and Simpson, was simply one of those peculiar atmospheric effects which occasionally deceive the most experienced arctic travellers. The conclusion is, that no report of new arctic land is worth any thing until it has at least been very closely approached. — (*Isvestia imp. geogr. soc.*, May.) W. H. D. [559

Settlements on the Siberian coast. — Karzin gives a most valuable list of the settlements, summer fishing-stations, camps of ivory-hunters, and other places, where human beings are to be found at any season of the year on the coast of north-eastern Siberia. The chronicles of the Jeannette expedition might have been less gloomy, had the commander possessed himself of some such directory before proceeding on that unlucky voyage. — (*Isvestia imp. geogr. soc.*, May.) W. H. D. [560

(*Africa.*)

Sierra Leone. — According to recent consular reports, the population of this colony comprises sixty thousand five hundred souls, nearly all blacks, who speak among them more than sixty different dialects. Freetown, the capital, has a population of twenty-two thousand, chiefly of the Aku, Ebo, Timen, Susu, Maulang, Sherbru, and Krumen tribes. The Aku and Ebo people are extremely keen traders: the three following tribes furnish middlemen, who intervene between the caravan merchants and the purchasers. The last mentioned are freighters and boatmen, employed largely in loading and discharging vessels. The trade amounts to about three million dollars annually, less than half of which are exports. The soil is poor and not arable; farming is hardly practicable; and the real importance of the colony lies in its geographical position, and easy communication with the rich interior region. Taxes and customs-duties are very high, and have injured trade by driving it elsewhere. The exports are kola, palm and peanuts, palm-oil, gum-copal, rubber, ginger, and hides. — (*Bull. soc. Belg. géogr.*, ii. 1883.) W. H. D. [561

Portuguese Guinea. — Barros contributes a memoir on Portuguese Guinea, with notes on the customs and manners of the natives and on their language, especially of the Mandingo, Biafada, and Balanta tribes, containing little absolutely new except some songs. The article forms an interesting summary of facts. — (*Bol. soc. geog. Lisboa*, no. 12, 1882.) W. H. D. [562

BOTANY.

Cryptogams.

The oospores of the grape-mould. — Prillieux states that he has received from M. Fréchou of Nérac germinating oospores of Peronospora viticola. The germinating oospores produce at once a mycelial tube similar to that known in other species of Peronospora, in which the germination of the oospores has been seen. This is an important step in our knowledge of the grape-mildew, since, inasmuch as the conidia produce zoospores, it had been supposed by some that the oospores would also produce zoospores, as is the case in the related genus Cystopus. — (*Bull. soc. botan.*) W. G. F. [563

Swedish Algae. — Dr. C. Lagerheim describes a number of species new to Sweden, including several genera and species new to science. The species are from fresh water, as well as marine, and are illustrated by a plate. Of the genera treated most in detail may be mentioned Merismopedium. — (*Öfvers. svensk. akad.*) W. G. F. [564

Monograph of Ulvaceae. — The sixth part of Agardh's *Till algernes systematik* is devoted to the Ulvaceae. The author includes here the genera Bangia and Porphyra, as well as the green species generally placed in this order. The subject is elaborately prepared, and is illustrated by four colored plates giving the microscopic structure. Ulva and Enteromorpha are kept distinct, and E. erecta is credited to New York on the authority of J. Hooper. Monostroma pulchrum the writer suspects to be a form of M. lactuca, a boreal species of both hemispheres. — (*Acta univ. Lund.*, xix.) W. G. F. [565

Phanerogams.

Spines of Aurantiaceae. — Dr. Urban describes and figures specimens which show that the spines situated just above the leaf-axis of a number of members of this family, and hitherto considered as metamorphosed axillary branches, are in reality formed by the transformation of one or two of the lowest leaves belonging to the primary axillary shoot. — (*Ber. der deutschen bot. gesellsch.*, June 27.) W. T. [566

Orchis mascula. — Mr. Malair believes that the visits of bees to this species are for propolis, which is yielded by the papillae of the nectary. Flies also visit the flowers, which are described at length, but not very clearly nor accurately. — (*Science gossip*, March, April.) W. T. [567

Sterility of the Ficaria. — Mr. Neve notices that in England the plant seldom seeds, although its flowers appear well formed, and bees visit them. — (*Science gossip*, June.) W. T. [568

Pollination of willow. — Mr. Hamson states, that while amentiferous plants, dependent entirely upon the wind for fertilization, have pendulous catkins, "in the willow the catkins are upright and elastic. The humble-bee is a heavy insect, and it almost invariably mounts to the summit of the catkin, which is borne down by its weight. On the bee taking flight, the catkin springs suddenly to its original position, and thus shakes out the pollen in the male, and further distributes that which may have lodged in the scales of the female catkin." Bees were noticed to confine their visits almost exclusively to the staminate plants. — (*Science gossip*, July.) W. T. [569

ZOÖLOGY.

Protozoa.

Division of the nucleus in protozoa. — It is known that in many protozoa the number of nuclei increases with the growth of the animal; but whether the additional nuclei arise by free new formation, or by division of older nuclei, was uncertain, although Zeller had shown that the multiplication in Opalina was due to division. Gruber, in a valuable article, now shows that in Actinospaerium and Amoeba division of the nuclei occurs, having obtained examples after very long search. In the former the young nuclei are small, and have a single large nucleolus with a clear space around it. As the nucleus enlarges, the clear margin disappears, and the nucleolus breaks up into smaller granules (nucleoli). In one specimen various stages of division were found. Their natural succession is probably as follows: the nucleoli arrange themselves in two parallel rows across the nucleus; they then unite so as to form a homogeneous band out of each row; the rest of the nuclear substance accumulates between the two bands, which then move asunder, and meanwhile threads appear running from band to band; a line of division (partition-wall?) appears between the bands. In Amoeba proteus the nucleus contains a peripheral layer of

granules, and a large central mass to be regarded as the nucleolus. One specimen was found with nuclei in various stages of division. It appears that the nucleolus separates into two parts, between which, across the equator of the nucleus, appears a partition. Similar processes were observed in another Amoeba (sp.?). In these cases we have a form of nuclear division somewhat different from any hitherto observed; in that the nucleolus divides first, and the partition between is formed without the participation of the nuclear membrane.

Bütschli has asserted that in Amoeba proteus (princeps B.) the nuclei are either small and numerous, or large and few. Gruber has found them always of about the same size, and very variable in number and relative proportion to the bulk of the individual. — (*Zeitschr. wiss. zool.*, xxxviii. 372.) C. S. M. [570

Coelenterates.

The nervous system of the Siphonophores. — According to Korotneff, who has studied the minute anatomy and histology of the Siphonophores, the Diphyidae are the least modified, and present the most primitive or ancestral structure. In them the ectoderm is a simple muscle-epithelium with well-developed muscle-fibrillae, which lie upon *muscle-septa*, or outgrowths from the supporting layer.

A more highly differentiated organization is found in the Apolemiadae. The epithelial cells are nearly separated from the muscle-fibrillae, to which they are united only by fine protoplasmic threads. Between the muscle-septa the epithelial cells are folded over to form an open furrow, which is floored with cells a little larger than those over the general surface of the body.

In the Agalmidae the cells in this furrow are entirely covered up by the ordinary surface-epithelium. They are very large, are united by processes to the muscles, and they constitute a true central nervous system formed by involution of the ectoderm. The muscle-fibres of the Agalmidae are entirely separated from the epithelial cells, and the latter are flattened. Korotneff has traced the origin of the nervous system in the embryo. In a Forskalia larva there is no trace of nerve-cells; and the epithelio-muscular layer, the muscle-septa, and the endoderm are like the corresponding structures of Diphyes.

As the animal grows, these ectoderm-cells, which lie between the muscle-septa, grow larger, sink down, and become covered up by the ordinary surface ectoderm-cells. They then throw off processes to the muscle-fibres, and thus become converted into the nervous system. The nerve-cells are therefore, so far as their origin is concerned, epithelio-muscular cells, and they so far lend support to Kleinenberg's neuro-muscle theory.

Korotneff describes sensory cells in the region of the nervous system of the Agalmidae, and also in the air-bladder. These sensory cells are muscle-cells which still retain their primitive position on the surface; and they are furnished with sensory hairs, and are joined by processes to the muscle-fibrillae.

In the Physophora the ectoderm has been specialized in two ways. On the stem the cells have the morphological characteristics of nerve-cells and the position and arrangement which characterize muscle-cells: they are neuro-epithelio-muscular cells. There are also many sensory cells arranged in longitudinal rows among the ordinary cells; but there is no infolded nervous system upon the stem, as there is in the Agalmidae. This is to be found, however, upon the air-bladder, which is thickly covered with nerve-cells. On the upper surface of the bladder these are directly united to the surface-epithelium, while upon the lower surface they are directly united to the muscles. He says that there are physiological reasons (which are not stated) for believing that the upper nerve-cells are sensory, and those on the lower surface motor.

He speaks very briefly of the diffused nervous system of Porpita; and his observations apparently agree with those recently published more at length (see Science, ii. **396**) by Conn and Beyer. — (*Zool. anz.*, 148.) W. K. B. [571

Worms.

Systematic papers on worms. — Dr. R. v. Drasche has taken advantage of the preservation of all Diesing's and many of Molin's original specimens of nematods in the Vienna museum to draw up fresh and more accurate diagnoses of the species described by these authors, and also to give a good many new figures. This labor is calculated to avoid much confusion which might otherwise arise from the very imperfect character of the original descriptions. — (*Verh. zool-bot. ges. Wien*, xxxii. 117.)

The same author also describes some new ascarids collected in Brazil by Natterer, and adds some notes on Ascaris ovis and A. rigida. — (*Idem*, 139.)

G. M. R. Levinsen has published the first part of a valuable revision of northern Annulata, Gephyrea, Chaetognathi, and Balanoglossi. He attempts chiefly to describe the species, elucidate their history in scientific writings, and their geographical distribution. The essay contains full synoptic tables. The work was undertaken at the request of Prof. Steenstrup and Dr. Lütken. — (*Vidensk. meddel. naturh. foren. Kjöbenhavn*, 1882, 160.) C. S. M. [572

Pentastomum from an Alligator lucius. — J. Chatin has found Pentastomum, probably P. oxycephalum, in the liver of a caiman. This is a new locality for the parasite. He gives an excessively prolix general account of the anatomy of the animal, but contributes little that is new. The hooklets around the mouth have a stalk, and three movable claws thereon, — two at the sides near the end, the third terminal. The author denies the cellular character of the epidermis: it is 'formed merely by a mass of protoplasm in which are scattered numerous nuclei.' (It can hardly be questioned that this is a mistake due to superficial observation. The author gravely adds his doubts as to the cellular constitution of the epidermis in arthropods generally. In this he is singularly unfortunate; as there is hardly any fact in insect histology more easily verified, even by inexperienced students, than the existence of epidermal — so-called hypodermal — cells. The error of describing an epi-

thelium as a sheet of protoplasm with scattered nuclei has been committed over and over again by persons not trained in histology.) The description of the course of the nerves rectifies previous accounts. — (*Ann. sc. nat. zoöl.*, xiv. art. 2.) C. S. M. [573

Crustaceans.

Isopoda of the Blake dredgings. — In a report on the Isopoda dredged on the east coast of the United States in 1880, by the U. S. coast-survey steamer Blake, under the direction of Alexander Agassiz, Oscar Harger says that the collection, although small, is remarkable for the large proportion of interesting forms; since nearly all the species are either new, or not hitherto known upon our coast, or known only from single specimens. Nine species, all belonging to Cirolanidae and Aegidae, are enumerated, and most of them fully described and figured on four excellent photo-lithographic plates from the author's drawings. — (*Bull. mus. comp. zoöl.*, xi., no. 4, Sept., 1883.) S. I. S. [574

Development of Panopeus. — E. A. Birge describes and figures the post-embryonal and some of the later embryonal stages of Panopeus Sayi and the second zoea stage of P. depressus. He describes four distinct zoea stages after the casting of the embryonic cuticle (or 'larval skin,' as Prof. Birge calls it) and a 'first megalops stage,' and discusses the metamorphoses undergone by the body and appendages in the change from each stage to the next. After describing the 'first megalops stage,' Prof. Birge says, "Subsequent changes in the megalops affect the proportions of the carapax, which becomes broader proportionally, and that of the abdomen, which becomes smaller, and is permanently flexed under the sternum. The appendages undergo many changes, gradually approximating them to the adult form. The last stage is reached after several — at least four — moultings." Unfortunately none of these remarkable later megalops stages are described or figured, as they certainly deserve to be if actually observed. During several seasons' observations the writer has found no evidence of more than one megalops stage in this or allied species; and, with the exception of Bate's doubtful observations on Carcinus, there are apparently no well authenticated cases of several megalops stages in any species of Brachyura. The numerous figures illustrating the paper are rude and inaccurate. — (*Stud. biol. lab. Johns Hopk. univ.*, ii., no. 4, July, 1883.) S. I. S. [575

Insects.

Sucking-apparatus in butterflies. — P. Kirbach describes the structure of the maxillae and pharynx in the Lepidoptera precisely as described by Burgess in the *American naturalist* for May, 1880, and more at length in a memoir on the anatomy of the milkweed butterfly in the *Anniv. memoirs Bost. soc. nat. hist.*, 1881. Kirbach makes no reference to either of these papers, though both were recorded in the very journal containing his article, as well as in Carus's *Zool. jahresbericht* by Bertkau, in the *Arch. f. naturgesch.*, and in the *Zoölogical record*. However, it is satisfactory to have observations independently confirmed; and Kirbach gives almost a verbal and pictorial repetition of the above-quoted papers. Thus the suspensory muscles of the pharynx receive the identical names given them by Burgess. Kirbach believes the proboscis is extended by muscular contraction, and rolled up by elasticity, but gives no proof of his view. This is the opposite of what the muscular arrangement *seemed* to Burgess to indicate; although he added that "it is more probable we fail to see, or to correctly interpret, some proper muscular mechanism for both movements of the proboscis." Unfortunately, Kirbach does not help us here.

Kirbach describes, for the first time, the syringe-like mechanism of the salivary duct, by which saliva is injected into the proboscis. This arrangement was overlooked by Burgess. — (*Zool. anz.*, vi. 553.) E. B. [576

Wheat-stem maggot or bulb-worm. — The larva of Meromyza americana Fitch has been very destructive this year to wheat and rye in Fulton county, Ill. Important additions to the published observations of Fitch, Riley, and Lintner, have been made by S. A. Forbes, who gives descriptions and figures of all stages of this insect. The egg is now figured for the first time, and a winter brood has been observed. — (*Prairie farmer*, Aug. 4.) J. H. C. [577

VERTEBRATES.

Histology of the nervous centres. — C. Golgi has investigated the morphology of ganglion-cells. His conclusions are in some respects very different from those of previous investigators, and, if confirmed, will mark an important advance in our knowledge of the subject. On this account we give a longer abstract than usual for special papers.

The origin of the nervous fibres depends on certain constant laws, uniform for the different centres, despite certain secondary differences in the morphology and distribution of the histological elements. The ganglion-cells may in general be distinguished from the other cells by their form, the appearance of their nuclei, and the mode of origin of their prolongations; but they are especially characterized by the presence of the *single* nervous (Deiter's) process, which *alone* enters into connection with the nerve-fibres to make part of, or constitute them. The protoplasmatic processes have nothing to do with the origin of the nerve-fibres, directly or indirectly: they are in relation with the connective-tissue corpuscles (exactly how is not shown, so this may be questioned). As each cell has only one Deiter's process, it follows that they are all really unipolar. The sensory and motor cells cannot be distinguished definitely by their form or size from one another; but, as regards Deiter's process, two forms are distinguished, — the first is supposed to go with the motor cells, the second with the sensory. The established view that the process is continued without branching into the axis-cylinder is discarded; for Golgi maintains that it gives off a more or less considerable number of filaments on its way. In the first form, the process, although giving off filaments, still maintains its individuality, and can be followed to the points where it enters the

medullary sheath as the axis-cylinder. Corresponding nerve-fibres are found, which preserve their individuality, notwithstanding the filaments they give off from the axis-cylinder, which can be followed to the ganglion-cells. The structures are supposed to belong to the sensory system. In the motor system the individuality of the process or of the fibre is lost in the gray substance, completely breaking up into filaments which enter into the formation of a diffuse network. It would appear, then, that the motor process breaks up into filaments, forming a network, from which spring the other filaments, which unite to form the motor axis-cylinder. The network really receives filaments also from the sensory process and fibres; so that it may be regarded as a fundamental nervous plexus, both sensory and motor, by means of which each fibre communicates, not with a single cell, but with large groups. The tendency is towards extended, not restricted, communications; and there is no anatomical basis for the assumption of the isolated transmission of peripheral nervous impulses to hypothetical limited cellular individualities. This investigation, therefore, lends no support to the theory of cerebral localization. Deiter's process is characterized from its origin by its greater homogeneousness, its hyaline aspect and smooth surface, while the protoplasmatic processes are granular.

Golgi has also studied the histology of the *cortex cerebri*, especially to compare the anterior with the occipital convolutions. Meynert's plates, and division of the cortex into five layers, he thinks, do not agree with the reality. Golgi distinguishes three forms of ganglion-cells, — pyramidal, fusiform, and globular (or polygonal with rounded angles). He distinguishes three layers of about equal thickness. The superficial layer is formed almost exclusively by rather small pyramidal cells; the middle layer has, for the most part, larger pyramidal cells; while in the deep layer the fusiform cells prevail, and the globular cells, which occur throughout the cortex, are here most abundant. The largest pyramidal cells extend through the whole thickness of the cortex. Such is the organization of the *gyrus centralis anterior* (*frontalis ascendens*). The organization of the superior occipital convolution is similar, except that the deep layer contains the globular cells almost exclusively. There are no anatomical features to indicate that the anterior convolutions are motor, the occipital sensory, as Hitzig and others have maintained. "The specific functions of the different cerebral zones do not depend on the organization of these zones themselves, but on the specific character of the peripheral organs which are connected with the fibres entering or leaving the zones in question." — (*Arch. ital. biol.* iii. 285.) C. S. M. [578

Birds.

Development of the heart. — Assaky maintains, 1°, that the heart arises in the chick as a double tube, as may be seen before the differentiation of the third protovertebra; 2°, the myocardium is constituted from the first by a network of anastomosing cells; the muscular fibres arise by endocellular generation; 3°, the muscle-cells are derived from amoeboid cells [i.e., are mesenchymal]. — (*Comptes rendus*, xcvii. 183.) C. S. M. [579

Plumages of the stone-chat. — Messrs. Butler, Fielding, and Reid seem finally to have solved the variations in plumage of this interesting bird. According to them, there are nine different stages easily recognizable. We note with satisfaction that the theory of hybridization seems to be done away with. — (*Ibis*, 1883, 331.) J. A. J. [580

Mammals.

The influence of quinine upon heat-dissipation and heat-production. — In a late article by Wood and Reichert (*Journ. of physiol.*, iii. 321), the authors make the statement that quinine increases both heat-production and heat-dissipation, though, on the average, the percentage of increase of heat-dissipation largely exceeds that of heat-production. A desire to test the accuracy of these results has led Arntz to make a similar series of experiments. To measure the relative amount of heat-dissipation from the skin, he made use of a porous wooden cap, lined with felt, which could be applied to any part of the body. The temperature within the space thus enclosed was registered by a delicate thermometer. Any increase in the loss of heat through the skin would be shown, therefore, by the thermometer. Experiments were made upon men and rabbits in a normal healthy condition, the general results of which show that no increase in heat-dissipation follows the injection of quinine. To explain the contradiction existing between his own and Wood's results, he supposes that the doses used by the latter were too large for the animal (dog) experimented upon; and the increase in heat-dissipation was probably owing to the animal's struggles and attempts to vomit. Two experiments that he made upon dogs, using the same dose as that given by Wood, tend to support this explanation. To determine the effect of quinine upon heat-production, spirometric observations were made upon normal rabbits, and rabbits suffering from septic fever, the amount of oxygen absorbed being taken as an indication of the oxidations going on in the body. In normal rabbits, quinine was found to have no effect upon the amount of oxygen consumed; while, in febrile animals, it caused a diminution in the oxygen-consumption. The author's conclusion, with regard to the anti-pyretic action of quinine, is, that it acts in the first place indirectly by destroying the organisms which give rise to the fever, and, in the second place, directly diminishes the oxidations in the tissues of the body. — (*Pflüger's archiv*, xxxi. 531.) W. H. H. [581

Action of carbon dioxide and oxygen upon the mammalian heart. — The present paper by Klug forms an extension of some previous work of the same nature on the frog's heart. His experiments were made upon dogs anaesthetized by means of morphia, and made to breathe in an atmosphere containing different percentages of carbon dioxide or oxygen. With regard to the action of carbon dioxide he finds, in accordance with previous observers, that it acts as

a stimulus to the vaso-motor and cardio-inhibitory centres of the medulla; but, in opposition to the statements of Traube and Landois, he asserts that it disables the intrinsic motor centres of the heart. He grounds this statement on the fact, that, after section of the vagi and the cervical cord, the heart soon ceases to beat, when the animal breathes in an atmosphere containing from twenty to forty per cent of carbon dioxide. Breathing in an atmosphere of oxygen stimulates both the inhibitory and accelerator centres of the medulla: and the author repeats for the mammal a statement made with reference to the frog; viz., that oxygen acts as a constant stimulus for the heart-contractions. Want of oxygen, like carbon dioxide, stimulates the inhibitory and vaso-motor centres, and first stimulates, then depresses, the accelerator centres. — (*Arch. anat. physiol.*, 1883, 134.) W. H. H. [582

Maturation and impregnation of the mammalian ovum. — G. Rein has investigated these phenomena in rabbits and guinea-pigs. He describes minutely his manner of obtaining the desired material. In rabbits the tuba can be cut open, and examined with a lens: in guinea-pigs it is better to collect the eggs by pressing out the excised tuba with a blunt instrument. They may be examined fresh in the fluid from the oviduct, and even kept so for some time, if the cover-glass is surrounded by a rim of oil, and the slide placed in a warm box. To preserve the eggs, fix with (.1%–1%) osmic acid, place them for two or three days in Müller's fluid, and mount in glycerine.

The so-called corona radiata consists of the cells (changed to the spindle form) of the discus proligerus. It is most marked in the rabbit immediately before the bursting of the Graafian follicle, i.e., nine to eleven hours after copulation; by which time one polar globule has generally been formed. The cells of the corona present features most unusual in epithelia: they are elongated, spindle or star shaped, with processes which branch often and anastomose with one another; they are probably forced apart by the liquor folliculi, which accumulates, especially during the last hours before the bursting of the follicle; after that event they resume their original form. As the ovum matures, the nucleus is distended, and assumes an eccentric position and oval form. The nucleolus is replaced now by a cluster of granules, which then scatter themselves through the yolk, become smaller and ultimately indistinguishable. The nucleus comes to lie close against the zona pellucida, and there is flattened out. The next change is the expulsion of the first polar globule, which appears to be formed out of the germ-vesicle. No karyokinetic figures were observed in connection with the process. Rein suggests that possibly the mammalian polar globules are not complete homologues of those of the lower animals. The maturation is further marked by the contraction of the yolk, first, at the point where the polar globule is ejected; second, general, so that the yolk recedes, as in other mammalia, from the zona pellucida. In three cases active protuberances on the yolk were observed (cf. Kupffer, ante, i. **1132**). In the mature ovum also appear yolk-grains larger and much darker than the other granules. In four cases a second nucleus was observed more in the centre of the egg, probably the egg-nucleus (or female pronucleus).

Impregnation takes place in the middle third of the tuba thirteen to seventeen hours after copulation. Two pronuclei (male and female) are seen in the ovum: they travel towards one another, meet eccentrically, make amoeboid movements, and sometimes are quite near the surface. The radiating lines could not be seen in most cases around the pronuclei. At the time of impregnation the cells of the corona have partly fallen off. Numerous spermatozoa crowd around the egg, several pass the zona; but probably only *one* enters the yolk. The pronuclei pass to the centre of the ovum, the amoeboid movements continue; one pronucleus becomes crescent-shaped, and embraces the other: the two then probably unite. — (*Arch. mikros. anat.*, xxii. 233.) C. S. M. [583

Duration of systole and diastole of heart-beat. — From a series of experiments made upon the dog, Howell and Ely have come to the conclusion that variations of arterial pressure from fifty millimetres to a hundred and sixty millimetres of mercury have no direct effect whatever upon the duration of either systole or diastole. The experiments were carried out upon hearts completely isolated from every other organ of the body, except the lungs, after the method devised by Prof. Martin. The contractions of the heart were registered by means of a Fick spring manometer connected with the cavity of the right ventricle, and the time relations of the beat were determined by comparing this curve with the simultaneous tracing of a tuning-fork vibrating fifty times a second. — (*Stud. biol. lab. Johns Hopk. univ.*, ii. 453.) W. H. H. [584

ANTHROPOLOGY.

Tattooing among civilized people. — Last December Dr. Robert Fletcher read a paper on tattooing among civilized people, which he is now publishing. The custom presents itself from two points of view, — the medico-legal and the anthropological. Compared with the elaborate tattooing of many savage tribes, the designs which sailors, soldiers, and, above all, criminals, have imprinted on their persons, are trivial or offensive in subject, or clumsy in execution. In 1869 Berchou made several reports to the French government on tattooing among sailors and criminals, and published a work entitled 'Histoire médicale du tatouage.' At the meeting in Algiers in 1881, of the French association for the advancement of science, Magitat exhibited a chart showing the geographical distribution of tattooing, according to methods, as follows: 1. By pricking; 2. By simple incision; 3. By ulceration or burning; 4. Hypodermic tattooing; 5. Mixed tattooing. Among the distinguished observers of this practice are Cesar Lombroso of Turin, and Dr. A. Lacassagne of Lyons. Lombroso publishes a chapter on tattooing in his 'L'uomo deliquente,' and Lacassagne is the author of a volume entitled 'Les tatouages, étude anthropologique et médico-légale.' He gives a table showing the parts of the body oper-

ated upon in 378 subjects, and also one containing the details of 1,333 tracings obtained from the battalion d'Afrique, as follows:—

Patriotic and religious emblems	91
Professional emblems	98
Inscriptions	111
Military emblems	149
Metaphorical emblems	260
Amorous and erotic emblems	280
Fantastic, historical, and miscellaneous,	344
	1,333

The reader will find this one of the most entertaining and instructive anthropological papers which have appeared in a long time. — (*Trans. anthrop. soc. Washington*, ii. 40.) J. W. P. [585

The Mexican pulque. — "One of the first objects to claim the attention of the conquerors of Mexico," says Carl Beni, "was the maguey-plant (Agave americana; Mexican, *neuttli*). Its manifold uses and products, considered in relation to the inhabitants of that region and to their manner of living, render interesting the study of this vegetable, which is justly called *pianta delle meraviglie*." De Candolle thinks that the plant is of Mexican origin; but the place where it was discovered to furnish a beverage is uncertain, for traditions concerning it are intimately connected with the history of the ancient peoples who occupied the central plateaus of South America. According to the Mexican traditions, Ixquitecatl was the first to invent the method of drawing the sweet juice from the maguey, and Titlacahuan used pulque to intoxicate Quelzalcoatl and to induce him to go into exile. Another legend says, that in 1045 the juice of the plant was introduced as a drink among the royal family. Signor Beni has collected from various sources the references to the uses of this celebrated plant, and in 1876, while in Mexico, made some observations on its cultivation and uses. The following is the analysis of the sap and of the fermented liquor:—

	Sap.	Pulque.
Albuminous substances	25.40	12.57
Sugar	95.53	8.23
Salts	7.26	2.20
Absolute alcohol	0.00	36.80
Water, gas, and waste	871.81	940.20
	1000.00	1000.00

— (*Archiv. per l'antrop.*, xiii. 13.) J. W. P. [586

The use of mollusks. — Dr. A. T. de Rochebrune has written a second memoir upon mollusks among ancient and modern peoples, this time treating of shells in the sepulchres of Ecuador and New Granada. The mounds of the United States furnish some beautiful specimens of aboriginal art in shell, and our archeologists have not been slow in taking advantage of the interest clustering about these objects. The relative rarity of mollusks utilized by the ancient inhabitants of the Peruvian coast is noticed by M. Rochebrune. The farther north we go, the more pronounced this poverty becomes. Indeed, the following five species are all that the author has found from that region:—

1. Spondylus limbatus Sow, statuettes and necklaces.
2. Venus multicostata Sow, spangles, necklaces.
3. Patella olla Brod., bangles, quippus(?) beads.
4. Oliva splendidula Sow, bangles, pendants.
5. Fasciolaria salmo Wood, pieces for clothing.

Two or three of the objects are carved with some elaborateness of design. — (*Rev. d'ethnog.*, ii. 311.) J. W. P. [587

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Comparative paleontology of the Devonian formation. — Prof. H. S. Williams has recently been devoting his attention especially to this formation in western New York, and, in a preliminary report to the director, makes known some interesting facts as a result of his study of the materials collected by him during the past summer.

In the black shales, which in New York lie between beds containing Hamilton faunas below and those bearing Portage faunas above, he has found Lingulas indistinguishable from those of the Cleveland shales; also conodont teeth identical in form with those described from the same Cleveland beds, and Sporangites and Palaeoniscus scales. Species, therefore, regarded by Ohio geologists as characteristic of the Cleveland shales (Waverly), occur together in a similar black shale in New York, which there is known to underlie the upper Devonian. Professor Williams says, however, that, although the identity of the two faunas can scarcely be disputed, he is not so sure that it is an indication of synchronous deposition. The various black shales of Ohio are more nearly continuous there than in New York; and he says it is pretty clear that the intercalated sandy deposits are of a more eastern origin. At the horizon of upper Devonian the sands are purer and of lighter color as we go westward and south-westward; and in some of the quarries of western New York, sandstones very similar to the Ohio Waverly stone are met with. In these sands distinct quartz pebbles have been found, nearly as low as the point where the first member of the typical Chemung fauna is obtained, leading Professor Williams to suspect that true conglomerates may, in some geographical area, have been contemporaneous with the early Chemung fauna. He says the evidences are accumulating in support of the hypothesis that the lower conglomerates are the geographical representatives of deposits of much finer character farther north, in which the Chemung faunas appear. He meets the

argument for a high geological position of the conglomerates (based on an assumed regular dip towards the south-west in this region) by the supposition that conglomerates must express nearness to shore, and that, running along a line from shore into deep water, it is safe to assume that for any given length of time the thickness of the deposit will diminish with the distance from the shore; and hence, if the general relation of shore to deep water continued through the upper Devonian, the dip of the strata will diminish as we ascend in the series, and the tendency of one who depended upon a general rate of dip would be to reckon the more southern deposits too high. Professor Williams has good evidence that this has been done for the sands of Wyoming and Alleghany counties.

Professor Williams's observations lead him to the opinion (which may be modified by further facts), that the sandstones lying at the top of the series at Portage Falls, barren of fossils so far as reported, are, when taken as a mass, stratigraphically identical with the lower Chemung sandstones farther south and west, and that geographical conditions had more to do with the presence or absence of the Chemung fauna than had the geological time of the deposit, after once the Chemung fauna appeared in the sea.

The present stage of Professor Williams's investigations leads him to the following opinion as to the distribution of faunas at this mid-upper Devonian for the eastern area: —

1. A Hamilton fauna coming in from the east and north, and extending around the southern border of the old paleozoic continent into the interior sea, through Canada West, Michigan, etc., to Iowa, etc.

2. A black slate fauna, at first reaching quite to the eastern New York areas, but, with the advance of time, oscillating back and forth, each stage withdrawing farther and farther to the west and south.

3. A sparse Portage fauna, mainly small lamellibranchs and pteropods and cephalopods, rather pelagic in character, common over the New York area, but whose centre or origin he is unable to trace.

4. A Chemung fauna from the south and east, pushing northward with the withdrawal of the Hamilton fauna, mingling with it at first in eastern New York areas, but in western New York not appearing at all until the complete withdrawal of the Hamilton fauna.

There are also traces of a fifth fauna over this region; for, as the Chemung fauna is followed towards the western part of the state, species characteristic of the subcarboniferous of the interior begin to appear, both in the nature of the varietal modifications of the species and in the rare new forms mixed with the Chemung species, leading to the suspicion that the subcarboniferous faunas of the western interior may have been contemporaneous with the Chemung faunas of New York and Pennsylvania. He says, however, that the solution of this problem must be left until a more thorough study of the western interior deposits and their faunas is made, and that the problems involved are too complex to make hasty generalizations safe.

These investigations have been partly in the line of some remarks made by Professor James Hall in the 'Paleontology of New York' (vol. iv. part i., March, 1867, p. 257), where he speaks of the diminution of Devonian types and the augmentation of carboniferous types in the same beds in western New York, and also expresses the opinion that the mingling of Devonian and carboniferous aspects is due to geographical and physical conditions, and not to difference in age or chronological sequence of the beds which contain the fossils. Professor Williams is elaborating this idea, and is dissecting the faunas and tracing them to their centres of distribution.

NOTES AND NEWS.

PROFESSOR SYLVESTER, who has resigned the chair of mathematics at the Johns Hopkins university, and has been appointed to the Savilian professorship of geometry at the University of Oxford, sailed for Europe on Saturday last, Dec. 22. The night before his departure from Baltimore, a farewell assembly was held at the university in his honor. Mr. Matthew Arnold, who was present, made a brief speech. Resolutions were read on behalf of the board of trustees and of the teachers in the university, expressing their profound regret at the departure of Professor Sylvester, and the highest appreciation of his work and of the great stimulus his presence has given to mathematical research in this country. Professor Sylvester responded in a speech of characteristic warmth and *naïveté*, in which, along with most enthusiastic admiration and approval of the university he has helped to inaugurate, he took the opportunity of making some pointed suggestions. One of these was addressed to millionnaires, to whom he indicated several ways in which, while aiding the Johns Hopkins university, they might secure for themselves imperishable fame. Another pointed at the advisability of introducing a system of pensions or some equivalent provision for superannuated and disabled professors; and still another was a protest against the dismemberment of a university library by the establishment of specialized branches. Professor Sylvester's departure removes from the university not only the most distinguished scientific man, but the most interesting personality connected with it; and his absence will make a gap in the general life of the university no less than in his own department. It is hardly to our credit that no American college has conferred an honorary degree upon him during his residence in this country.

— In his recent address to the Royal society, President Huxley states that thirty-eight of the reports of the Challenger expedition have been published, forming eight quarto volumes, with 4,195 pages of letter-press, 488 lithographic plates, and other illustrations. Thirty-four of these memoirs are on zoölogical, four on physical, subjects. Nine reports are now nearly all in type, and some of them partly printed. These will be published within three months, and will form three zoölogical volumes with 230 plates and many

woodcuts, and one physical volume with many diagrams and maps: this latter volume will contain the report on the composition of ocean water, the specific gravity and temperature observations. A considerable part of the general narrative of the cruise is now in type, and nearly all the illustrations are prepared. The narrative will extend to two volumes; and it is expected they will be ready for issue in May or June, 1884. The work connected with the remaining forty-two special reports is in most instances progressing satisfactorily. Portions of the manuscript for three of the larger memoirs have been received and put in type, and the manuscript of many others is in a forward state. For these memoirs, 386 lithographic plates have been printed off and delivered to the binders, 404 others are now on stone, and the drawings for many more are being prepared. It is estimated that the whole work connected with the report will be completed in the summer of 1887.

— Professor Huxley also expresses a regret that the admirable energy of the government in taking measures to make the recent advances of medical science available during the late outbreak of cholera in Egypt was not extended beyond the purely practical side of the matter, or perhaps not so far as the practical side in the proper sense; for, until we know something about the causes of that terrible disease, our measures for prevention and for cure will be alike leaps in the dark.

Those, he says, who have looked into the literature of cholera may perhaps be disposed to think that a new search after its cause will add but another to the innumerable wild hypotheses which have been set afloat on that topic; and yet devastating epidemics, like the pebrine of the silkworm, so similar in their fatality and their apparently capricious spread that careful investigators have not hesitated to institute a detailed comparison of the phenomena of this disease with those of cholera, have been proved by Pasteur to be the work of microscopic organisms; and hardly less fatal epidemics, such as splenic fever, have been traced to similar agencies. In both these cases, knowledge of the causes, and of the conditions which limit the operation of the causes, has led to the invention of effectual methods of cure. And it is assuredly, in the present state of science, something more than a permissible hypothesis, that the cause of cholera may be an organic living materies morbi, and that the discovery of the proper curative and prophylactic measures will follow upon the determination of the nature and conditions of existence of these organisms.

If this reasoning is just, it is certainly to be regretted that the opportunity of the outbreak of cholera in Egypt was not utilized for the purposes of scientific investigation into the cause of the epidemic. There are able, zealous, and courageous young pathologists in England who would have been willing enough to undertake the labor and the risk; and it seems a pity that England should leave to Germany and to France an enterprise which requires no less daring than arctic or African exploration, but which, if successful, would be of a thousand times more value to mankind than the most complete knowledge of the barren ice-wastes of the pole or of the sweltering barbarism of the equator. It may be said that inquiries into the causation of cholera have been for some years conducted in India by the government without yielding any very definite result; but this is perhaps rather an argument in favor of, than against, setting fresh minds to work upon the problem.

— Professor George Davidson read papers at the meeting of the California academy of sciences, Nov. 5, on the solar eclipse of Oct. 30, 1883, and the appearance of Saturn as seen at the Dearborn observatory under very favorable conditions. He said of the latter, "The evening was clear and pleasant, and nearly calm. . . . The atmosphere was charged with aqueous vapor, and the dew ran down the observatory almost like rain. . . . But one of the best revealed features . . . was the undoubted difference in brightness of the gauzy ring at the two ansae. The preceding part was decidedly brighter than the following ansa. . . . I should mention, that, in my limited experience in examining Saturn, I have never seen the atmospheric conditions so nearly perfect as they were that night. . . . I saw more than is given in the beautiful Cambridge drawing."

Professor Davidson also spoke of a brilliant meteor as follows: "On the evening of Oct. 29, at eleven o'clock, a remarkably brilliant meteor passed vertically downwards very near to Eridani (3 mag.). It illuminated the street, and its light cast a strong shadow. The train, about five degrees long, was persistent for three or four seconds, with an intense, vivid brightness, then faded away to a white, vaporous-looking streak, which assumed a wavy motion for three or four seconds, and then vanished. The color was an intense white, tinged with a purplish hue; and the brightest part of the train which was left was not at the point of disappearance, but about the middle of its length."

At a later meeting of the academy, Professor Davidson spoke of Trouvelot's red star, seen during the solar eclipse of May 6, and took the ground that δ Arietes was the star seen by Trouvelot.

Full accounts of all these papers were given in the *Mining and scientific press*, San Francisco.

— We take the following account of the awards of medals recently made by the council of the Royal society from Professor Huxley's presidential address: —

The number, the variety, and the importance of Sir William Thomson's contributions to mathematical and experimental physics are matters of common knowledge; and the fellows of the society will be more gratified than surprised to hear that the council have this year awarded him the Copley medal, — the highest honor which it is in their power to bestow. Sir William Thomson has taken a foremost place among those to whom the remarkable development of the theory of thermodynamics and of electricity in the last forty years is due. His share in the experimental treatment of these subjects has been no less considerable; while his constructive ability in applying science to practice is manifested by the number of instruments bearing his name which are at present in use in the physical laboratory and in the tele-

graph-office. Moreover, in propounding his views on the universal dissipation energy and on vortex motion and molecular vortices, Sir William Thomson has propounded conceptions which belong to the prima philosophia of physical science, and will assuredly lead the physicist of the future to attempt once more to grapple with those problems concerning the ultimate construction of the material world which Descartes and Leibnitz attempted to solve, but which have been sedulously ignored by most of their successors.

One Royal medal has been awarded to Dr. T. Archer Hirst, F.R.S., for his investigations in pure geometry, and more particularly for his researches into the correlation of two planes and into the complexes generated by them.

The other Royal medal has been awarded to Dr. J. S. Burdon Sanderson, F.R.S., for the eminent services which he has rendered to physiology and pathology, and especially for his researches on the electrical phenomena exhibited by plants, and for his investigations into the relation of minute organisms to disease. In making this award, the council desire not merely to recognize the merit of Dr. Burdon Sanderson's researches, especially those on the analogy between the electrical changes which take place in the contractile tissues of plants and those which occur in the like tissues of animals, but to mark their sense of the important influence which Dr. Sanderson has exerted upon the study of physiology and pathology in this country.

The Davy medal has this year been again awarded in duplicate; the recipients being M. Marcellin Berthelot, member of the Institute of France, and foreign member of the Royal society, and Professor Julius Thomsen of Copenhagen. The thermochemical researches of Berthelot and Thomsen have extended over many years, and have involved an immense amount of work, partly in the application of established methods to new cases, partly in devising new methods and applying them to cases in which the older methods were not applicable. Chemists had identified a vast variety of substances, and had determined the exact composition of nearly all of them; but of the forces which held together the elements of each compound they knew but little. It was known that certain elements combine with one another with great evolution of heat-forming products in which they are firmly united; while other elements combine but feebly, and with little evolution of heat. But the materials for forming any general theory of the forces of chemical combination were but scanty and imperfect. The labors of Messrs. Berthelot and Thomsen have done much towards supplying that want, and they will be of the utmost value for the advancement of chemical science.

— Dr. Charles W. Dabney, director of the North Carolina agricultural experiment-station, has issued a circular urging the necessity of a strictly scientific agricultural journal in this country, either a quarterly or monthly. Those interested should address Dr. Dabney at Raleigh, N.C. The station at Raleigh is reported to be in a prosperous condition.

— The next number of the *Journal of the Cincinnati society of natural history* will contain a biographical sketch and a steel-plate portrait of the late V. T. Chambers, the entomologist. Mr. Chambers was at one time president of the society, and at all times one of its most active members.

— The Ohio mechanics' institute of Cincinnati has inaugurated á series of popular scientific lectures on a plan pursued in former years. The lecturers and the topics for this series are as follows: Prof. T. C. Mendenhall, 'The electric light;' Prof. C. L. Mees, 'Molecular motion and crystallization;' Prof. F. W. Putnam, 'Ancient arts of North-American nations;' Dr. A. Springer, 'The cell and its functions;' Prof. E. S. Morse, 'Japan;' Prof. Thomas French, jun., 'Sound;' Prof. W. L. Dudley, 'Water;' Prof. T. H. Norton, 'Recent advances in chemical technology;' Prof. J. B. Porter, 'Mining and metallurgy.' The first two of these have already been given. The others will follow at intervals of about two weeks.

— The course of free popular scientific lectures just concluded by the Cincinnati society of natural history was a great success. Eight lectures were delivered on topics connected with zoölogy by members of the society. They were given every Friday evening from Oct. 19 to Dec. 7, and were attended by as large audiences as the lecture-room would accommodate. The lecture committee is arranging for another course, to begin on Jan. 4; and these lectures will treat of topics connected with geology and mineralogy. 'Gems,' 'Marbles and corals,' 'Physical geography of the United States,' and 'Fossil botany,' are some of the subjects. The officers of the society deserve credit for their efforts to make the institution of practical educational value.

— It is proposed to hold during the year 1884, says *Nature*, an international exhibition, which shall also illustrate certain branches of health and education, and which will occupy the buildings at South Kensington erected for the fisheries exhibition. The object of the exhibition will be to illustrate, as vividly and in as practical a manner as possible, food, dress, the dwelling, the school, and the workshop, as affecting the conditions of healthful life, and also to bring into public notice many of the most recent appliances for elementary school-teaching and instruction in applied science, art, and handicrafts. The influence of modern sanitary knowledge and intellectual progress upon the welfare of the people of all classes and all nations will thus be practically demonstrated, and an attempt will be made to display the most valuable and recent advances which have been attained in these important subjects. The exhibition will be divided into two main sections, — I. Health; II. Education,— and will be further subdivided into six principal groups. In the first group it is intended specially to illustrate the food-resources of the world, and the best and most economical methods of utilizing them. For the sake of comparison, not only will specimens of food from all countries be exhibited, but the various methods of preparing, cooking, and serving food will be practically shown. The numerous processes of manufacture connected with the preparation of

articles of food and drink will thus be exemplified; and, so far as the perishable nature of the articles will admit, full illustrations will be given of the various descriptions of foods themselves. In the second group, dress, chiefly in its relation to health, will be displayed. Illustrations of the clothing of the principal peoples of the world may be expected; and a part of this exhibition, which, it is anticipated, will be held in the galleries of the Royal Albert Hall, will be devoted to the history of costume. In the third, fourth, and fifth groups will be comprised all that pertains to the healthful construction and fitting of the dwelling, the school, and the workshop, not only as respects the needful arrangements for sanitation, but also the fittings and furniture generally in their effect on the health of the inmates. The most improved methods of school construction will be shown; and the modes of combating and preventing the evils of unhealthy trades, occupations, and processes of manufacture, will form portions of the exhibition. The sixth group will comprise all that relates to primary, technical, and art education, and will include designs and models for school-buildings, apparatus and appliances for teaching, diagrams, text-books, etc. Special attention will be directed to technical and art education, to the results of industrial teaching, and to the introduction of manual and handicraft work into schools.

— The members of the polar meteorological station which Denmark maintained at Godthaab in Greenland have just returned to Copenhagen. According to *Nature*, the chief of the expedition, Lieut. A. Paulsen, reports, that, having left Copenhagen on May 18, 1882, in the sailing-ship Ceres, they arrived at Godthaab on June 14. On the voyage out, observations of the temperature of the sea and air were made every hour. On the arrival out, the expedition had to select the most suitable spot for the erection of the four wooden buildings brought with them, in which the magnetic and astronomical observations were to be made. A small mountain ridge near the church in the colony was chosen for this, as the preliminary researches in its neighborhood showed that the influence of iron strata on the magnetic current was here very small. The buildings were then erected, and the pillars raised on which the transit instrument, the great astronomical clock, and the eight different magnetical instruments, were mounted, and simultaneously the instruments for the meteorological observations were also placed; so that the weathercock and the anemometers, as well as the thermometer hut, were situated as free as possible. On Aug. 1 the meteorological observations could be commenced, but the magnetic ones were through an accident delayed until the 7th. From that date complete observations were made in exact accordance with the international programme, without interruption, every hour until Aug. 31 this year; and the expedition has thereby fully accomplished its object, viz., of obtaining a full year's magnetical and meteorological observations in this locality. A number of other scientific researches have also been pursued, of which those on the aurora borealis should particularly be mentioned. This phenomenon was frequently observed and studied during the winter, while some exceedingly valuable statistics were obtained as to the altitude of the aurora borealis above the earth's surface by measurements effected simultaneously in various places by light-signals. The measurements of atmospheric electricity have also led to valuable results. It is stated to have been the best equipped polar expedition ever despatched from Denmark.

— M. Langier, at a meeting of the Académie des sciences held on Oct. 22, described a method of disinfecting plants for exportation, practised by himself and Dr. Koenig at Nice. Some branches of vine infected with phylloxera were treated with a solution of sulphocarbonate of ethyl, the eggs and phylloxera being completely destroyed. The plants submitted to the trial do not seem in general to have suffered from it. For the first trials in disinfecting leaves and twigs, gaseous hydrocyanic acid was used, as proposed by Dr. Koenig; and for the roots and surrounding earth, sulphocarbonate of potassium in weak solution. Their experiments, they believe, will be of great service to the flower-cultivators of the Riviera.

— The distinguished French geodesist, M. Antoine d'Abbadie, writes to the editor of *Nature*, regarding units of angular measure, as follows: —

> "We probably owe our degrees either to the earlier supposed year of 360 days, or to the fact that this number has many divisors, although such divisors afford no practical advantage. When trigonometrical functions were subsequently discovered, it was found that the natural unit is not the circle, but the quadrant or right angle. Our system of numeration being decimal, it was then most convenient to divide the quadrant decimally; and the circle is thus considered as composed of four, forty, four hundred, etc., parts, according to the degree of exactness required. This was proposed by Briggs when preparing his logarithms, which are based on decimals; but unfortunately it was then set aside. Revived a long time after by Lagrange, it was acted upon by Laplace in his Mécanique celeste. Nowadays decimal divisions of the quadrant are the only ones used by French geodesists. . . . In Italy two geodesists were instructed to observe and calculate, in both the centesimal and the sexagesimal systems, the same large lot of angles. It was then found that the use of decimals gave a saving of two-sevenths of time, either in observation or in calculation. This result was unknown to Sir George Airy; but he judged rightly that the conversion of all sexagesimal angles into decimal ones would materially lighten his labors, and he actually did so when calculating all the lunar observations previously made at Greenwich."

— Prof. H. G. Van de Sande Bakhuyzen, the director of the observatory at Leiden, announces the completion of a new catalogue of star-places (began by Hoek, and continued by Dr. Kam, and contained in the first sixty-six volumes of the *Astronomische nachrichten*). The catalogue will contain nearly five thousand stars, reduced to the epoch 1855.0, with the data pertaining to the observations, and the usual elements for carrying forward the star positions.

— The last expedition of Lessar toward the Oxus was attended with severe hardships. He lost nearly all his animals; and to save his famished escort, almost destitute of water and provisions in the desert, he was obliged to seek assistance from the Khivans. Worn with three years painful and continual exploration, the explorer thinks of returning to Europe.

INDEX TO VOLUME II.

**** *Figures in black-faced type refer to the numbered paragraphs in the 'weekly summary;' those in ordinary type, to pages. Names of contributors are printed in small CAPITALS.*

ERRATA.

Page 61, col. 2, 5th line from bottom, for 'Alongshore, winds' read 'Along-shore winds.'
" **146**, " 2, 5th line from bottom, for 'Ayres' read 'Ayers.'
" **199**, " 2, line 13, for 'twenty-five hundred' read 'six hundred and ninety.'
" 250, " 2, last line of first article, for '3.37039 inches' read '3.37027 inches.'
" 395, in inscription of cut, for 'August' read 'July.'
" 403, col. 1, line 28, for 'Tosell' read 'Torell.'
" 403, " 1, " 34, for 'lithogical' read 'litbological.'
" 403, " 1, " 43, for 'Irving in' read 'Irving on.'
" 426, " 1, " 11, for 'similar' read 'only.'
" 430, " 1, " 12, for 'poorer oxidizing' read 'oxidizing power.'
" 430, " 1, " 32, for 'Purzgau' read 'Piurzgau.'
" 459, " 2, " 25, for 'refine' read 'define.'
" 465, " 2, " 10 of second article, for 'Koblanck' read 'Koblank.'
" 466, " 2, " 13, for 'practical' read 'practised.'
" 467, " 1, " 38, for 'of the surface' read 'on the surface.'
Page 467, col. 2, 11th line from bottom, for 'in the crayfish' read 'on the crayfish.'
" 468, " 1, line 19, for '0.145 inch' read '$\frac{1}{145}$ inch.'
" 468, " 2, " 1, for 'an angle' read 'air angle.'
" 468, " 2, " 32, for 'Clevinger' read 'Clevenger.'
" 469, " 2, " 5, " " " "
" 471, " 2, " 8, for 'Michan' read 'Mecham.'
" 483, " 2, 4th line from bottom, for '5 μ' read '.5 μ.'
" 523, " 2, last line, for 'Ifuagos' read 'Ifugayos.'
" 540, " 2, line 15 of second article, for 'Z. cavisortris' read 'Z. cavirostris.'
" 556, " 1, " 23, for '90°' read '45°.'
" 569, " 2, last line but one, for 'San Joan' read 'San Juan.'
" 570, " 1, line 18, for 'or Vancouver' read 'on Vancouver.'
" 607, " 2, " 9, for 'catalogue of mollusks' read 'catalogue of his collection of mollusks.'
" 701, " 2, note, for 'No. 42' read 'No. 41.'
" 722, " 2, " 38, for 'Hectarininae' read 'Nectarininae.'
" 735, in inscription of cut, for '1876' read '1870.'
" 802, col. 1, line 38, for 'Lanicera' read 'Lonicera.'
" 838, " 2, " 11, for 'Dearborn' read 'Davidson.'